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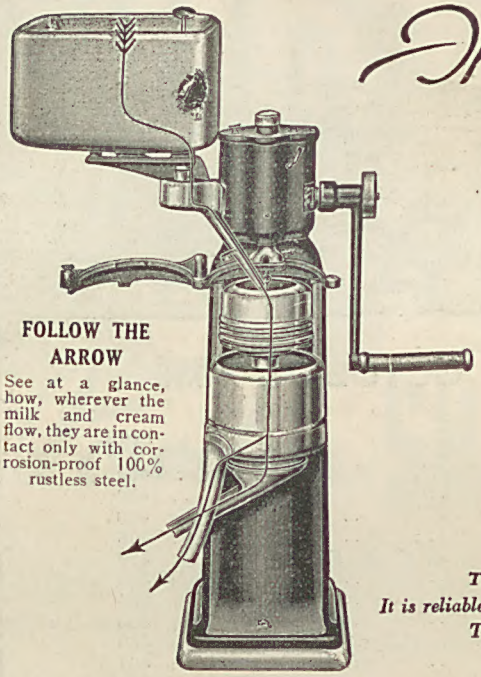

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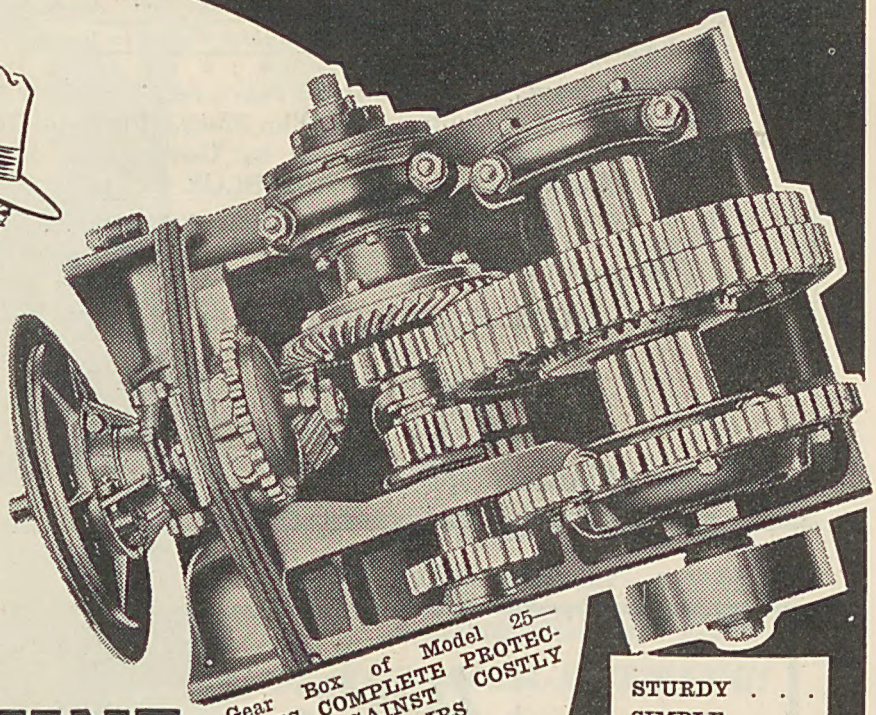

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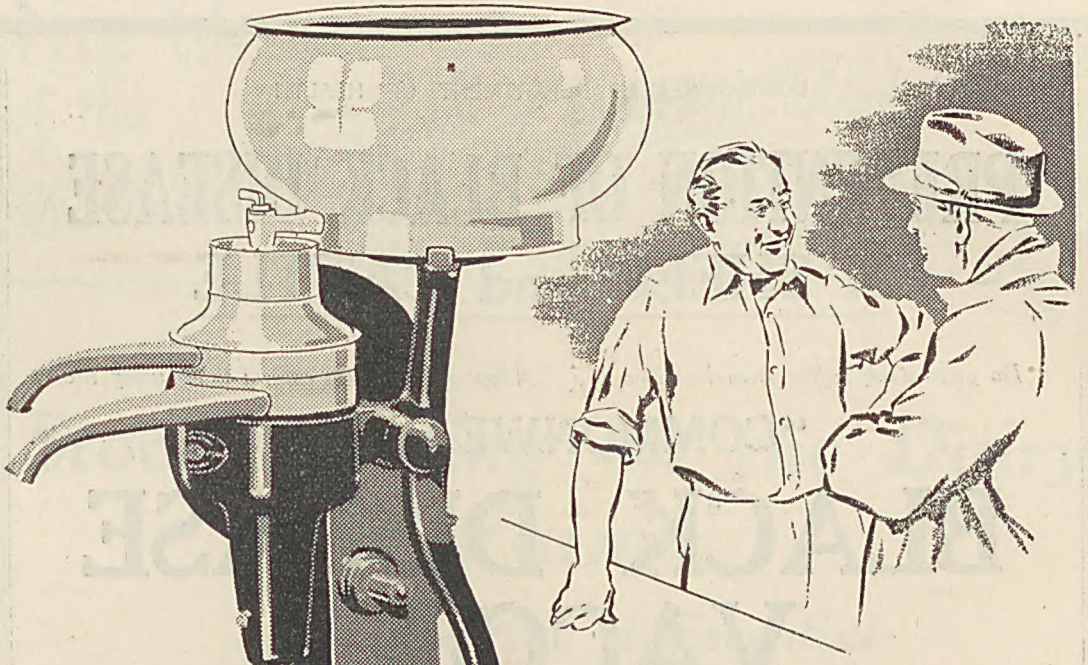

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The Journal of the DEPARTMENT of AGRICULTURE of VICTORIA

October, 1938.

Stock Feeding on the Dairy Farm

Supplementing is Essential

By A. C. T. Hewitt, M.Agr.Sc., Dairy Herd Manager, State Research Farm, Werribee

THE animals which can most economically convert food unfit for human consumption into wholesome foodstuffs are the cow and the pig. A "two-gallon cow" converts into milk one-third of the total digestible energy in her food; a "six-gallon cow" will change into milk over half the energy eaten. Milk, butter and cheese are the most cheaply produced human foodstuffs of animal origin.

The pig is as efficient with its food conversion as the two-gallon cow, since one-third of the digestible energy fed to it goes to the making of pork. From similar quantities of feed, a pig will produce 4 lb. of flesh, for every 2 lb. put on by a lamb and for every 1 lb. by a vealer or baby beef steer. At to-day's wholesale prices of one and twopence per gallon for milk, and seven pence halfpenny per pound dressed weight for bacon pigs, the returns for these commodities, on an energy basis, are the same. Milk is cheap at sevenpence per quart, retail, when bacon is more than one and fourpence per pound.

The Cow.

Pasture is the all-important feed for dairy cows. It requires little equipment and labour to secure the growth of feed, and apart from surpluses, cut and stored for later use, the cows do all the harvesting; no barns or buildings are necessary for storage of pasture and no labour is required for feeding. The high protein, mineral and vitamin contents, and the palatability of green pastures make them excellent fodders for milk production. Pastures should be encouraged by sowing the most suitable grasses and clovers for a particular locality, by top-dressing, rotational grazing and, where possible, by irrigation to produce the maximum amount of feed during as great a portion of the year as possible.

When pastures are properly cared for, hand-feeding is supplementary to grazing, and will be at a minimum in late spring and at a maximum in winter. Cows adequately fed during the autumn and winter will yield up to twice as much in the spring as they would if they were not properly fed, for those that have been allowed to fall off in condition must regain strength before they can produce maximum yields.

Many dairy cows are walking skeletons; starved because farms are overstocked and because the owners say that it does not pay to feed. The remedy is to run just such a number that sufficient

hay may be cut and conserved to be fed to the herd during late autumn, winter and early spring. The most progressive farmers like to conserve more hay than they will be likely to require in a normal year, and, so gradually accumulate a reserve to carry them through drought years.

Lucerne and clover hays are the best home grown fodders for milk production. Grass and oaten hays are good when green pickings are available; but they are deficient in protein, and a protein-rich supplement must be supplied in addition when pastures are dry. One such as meat meal, given at the rate of about one-third of a pound per cow daily is a cheap way of correcting protein deficiency. The argument that it does not pay to feed dairy cows at present butter-fat prices has some justification where all the feed has to be purchased and transported large distances; but it is not so when cheap home-grown fodders are available.

Silage is a particularly good supplementary foodstuff. Cutting a dense crop in the North East.

Supplementary feeding should be commenced as soon as the pastures are grazed too short for the cows to crop their fill; it must not be delayed until they have dropped conspicuously in their milk yields, or have lost condition. Such animals will probably show no response to supplementary feeding because the additional food will be utilized to rebuild body condition and not to increase the milk yield. In the winter months the aim should be to maintain a steady flow of milk and keep the cows in reasonably good condition.

The amount of work a cow has to do to gather sufficient pasture for her requirements is seldom realized. It has been found that one crops grass over about a sixth of an acre daily. Just imagine going over this area with a 14-inch lawn mower, and remember that a cow's mouth is only 3 inches wide. The cow producing 1 lb. of butter-fat daily requires from 130 to 150 lb. of fresh green succulent pasturage. In good pasture, a healthy active cow can gather this amount, but in poor scant pasture it is impossible, and without supplementary feed she will drop in her yield or lose condition.

Many dairy cows, calving while in good condition, frequently produce over two, and sometimes 3 lb. of butter-fat daily, but they cannot maintain these high yields for any length of time unless fed some concentrate as a supplement to pasture and home-grown roughage. A mixture of four parts ground barley, one linseed meal and one meat meal, and sufficient chaff to prevent a paste being formed in the mouth while the mixture is being eaten, makes a splendid supplement. In addition to pasture, and perhaps hay, about 10 lb. per day could be fed advantageously to the three-pound cow, and 4 lb. of the concentrate daily to the two-pound animal. Those producing 1½ lb. of butter-fat, or less, daily should not require any concentrate when good pasturage is available. For these, supplementary feeding, when necessary, can be restricted to roughages.

Grass hay has a similar food value to oaten hay and should be treated with just as much care. When chaffing oaten hay, the grain is sometimes winnowed out, ground and mixed again with the chaffed straw. Whether this practice is warranted is controversial. Certainly cows that are scouring badly or those receiving a protein-deficient ration pass noticeable quantities of grain in their droppings, but healthy animals fed balanced rations digest practically 100 per cent. of the grain.

Losses of undigested ground grain from cows are passed unnoticed. Farmers would receive greater returns from all their fodders if they made sure that the rations were properly balanced, that is, if the rations contained one part protein for every five of starch equivalent.

The Pigs.

Most successful dairy farmers keep pigs as a sideline for the profitable utilization of skim milk. The pig industry has received a very serious setback owing to several butter factories having installed casein plants and buying whole milk instead of cream. This means that the producer has no skim milk and therefore cannot rear pigs.

Pigs feeding on peas

When factories pay one halfpenny per lb. more for butter-fat supplied in whole milk, the return is less than one farthing per gallon for the skim milk, whereas skim milk is now worth at least one penny per gallon as pig food. With prime bacon pigs at sevenpence halfpenny per lb. dressed weight, factories would have to pay a bonus of twopence halfpenny per pound for butter-fat supplied in whole milk before it would pay the farmer to sell out of pigs and change over to supplying whole milk.

The problems of pig-feeding differ from those of feeding cows, because pigs are unable to digest fibrous roughages. Succulent pasture and skim milk are the best basal rations for pigs, with concentrate supplements, such as barley, pollard or maize. These supplements are essential for "topping them off." The pig is also a useful scavenger and can be fed surplus fruit and vegetables, household scraps, cooked meat and other edible wastages.

A grave mistake is commonly made by dairy farmers in selling their pigs when the supply of skim milk decreases, irrespective of whether they are "topped off" to the correct weights or not. This means loss to the seller, because pigs are definitely returning handsome profits over feed costs, and further, tends to spoil the market for pigs.

Supplementary feeding of cows and pigs during lean periods will guarantee a continuous supply of dairy produce which is essential if the highest returns are to be received and will help towards orderly marketing and efficient factory operation.

Adequate fodder reserves—the best insurance against drought.

Dairy Produce Supplies in 1937

UNFAVOURABLE weather conditions in Australia were reflected in a further reduction in the United Kingdom's imports of Australian butter last year, according to "Dairy Produce Supplies in 1937,"* a review just published by the Imperial Economic Committee. Imports from Australia were 12 per cent. and 29 per cent. less than in 1936 and 1935, respectively, and lower than in any year since 1930. Imports of Australian eggs also were appreciably less than in the preceding year, but on the other hand imports of cheese and condensed milk from the Commonwealth showed an increase while imports of frozen pork were fully maintained.

Rising prices for dairy produce were reflected in an increase in the value of the United Kingdom's imports of these commodities last year. The total cost of dairy produce, pig and poultry products imported during the year was £117 millions, or £9 millions more than in the preceding year, following an increase of £8 millions between 1935 and 1936.

In this connexion several factors were of importance during 1937. In Europe unfavourable weather and the incidence of foot-and-mouth disease affected production to a considerable extent and importing countries in certain cases relaxed restrictions on imports; in the Southern Hemisphere a second unfavourable season in Australia more than offset a further expansion in exports from New Zealand. There was also a considerable reduction in the United Kingdom output of butter, cheese, eggs and bacon, a movement no doubt in part due to the high price of feeding stuffs. From the point of view of demand, conditions were somewhat variable, for purchasing power continued to increase early in 1937, but suffered a set-back towards the end of the year; at this time a sharp increase in the price of butter was followed by a marked fall in its consumption.

The United Kingdom remained last year by far the most important market for dairy produce and allied products, but took a rather smaller proportion of world imports of butter and eggs, although slightly increasing its share of cheese. Recent years had witnessed an increase in the proportion of the United Kingdom's imports of dairy produce supplied by Empire countries, but this was checked for some of the chief commodities in 1936 and a further reduction, although in most cases small, was recorded last year.

Imports of butter into the United Kingdom in 1937, amounting to 9,416,000 cwt., valued at £47,400,000, were the smallest in any year since 1933. Imports from Empire countries comprised 52 per cent. of gross imports as against 53 per cent. in 1936 and 57 per cent. in 1935. New Zealand was again the principal source of supply, sending a record quantity, 6 per cent. more than in 1936 and comprising 31 per cent. of the total from all sources. Prices were for the greater part of the year above the 1936 level. The apparent consumption of butter is estimated at 24.8 lb. per head as against 25.0 lb. in 1936, but on the other hand margarine consumption rose from 8.6 lb. per head in 1936 to 8.9 lb. last year.

The United Kingdom's imports of cheese had declined in 1935 and 1936, but recovered in 1937, when a total of 2,937,000 cwt. was imported. Empire supplies were 8 per cent. heavier than in 1936, larger quantities being received from both New Zealand and Canada. The home production of cheese had declined appreciably in 1936 and there was an even greater reduction in 1937, so that in spite of the heavier imports, *per caput* consumption fell to 8.8 lb. as against 9.0 lb. in the previous year.

Imports of condensed milk in 1937 were very slightly smaller than in 1936, but imports of milk powder were 21 per cent. heavier.

Imports of eggs in 1937 were little greater than in the preceding year, larger imports from Denmark being offset by a reduction in supplies from other foreign countries and from Empire sources. Home production declined and the consumption of eggs per head of the population is estimated at 156, as compared with 158 in 1936. Prices for both home and imported eggs in 1937 were slightly greater than in 1936.

In addition to the comprehensive figures given for supplies and prices of dairy produce in the United Kingdom, the volume includes also a summary of the comparable data for the more important foreign countries and brief reviews of international trade in dairy produce and allied products. In addition, a survey is made of legislative measures affecting dairy produce in both the United Kingdom and foreign countries.

* "Dairy Produce Supplies 1937" published for the Imperial Economic Committee by H.M. Stationery Office. Price 2s. 6d. net (2s. 11d. post free).

Mac's Special tomatoes grown in the bush form at Portland.

Tomato Variety Investigations 1937—38

By Basil P. Krone, Fruit Packing Instructor.

DURING the 1936–37 season, twenty-six varieties of tomatoes were tested by the Victorian Department of Agriculture. Of these, the following gave satisfactory results:—Burwood Wonder, Bendigo Special Strain, Brittain's Best, Crimson Bell, Eccles Surprise, Heterosis, Kondine Red, Low Branch, Market King, Orange Prolific, Yellowtop (syn. Paleleaf), Recruit, Red Marhio, South Australian Dwarf and San Mazano. Several additional varieties were tested during the 1937–38 season. Thirteen of these can be recommended, as follows:—Scarlet Dawn, Early Baltimore, Illinois Baltimore, Mac's Special, John Baer (Bone's Selection), Early Shipper, Midseason Shipper, Canner 114, Sensation, Radio, Maori Chief, Sutton (from China), and Carter's Early Sunrise.

Eight of the varieties in the 1937–38 test are among the latest and most approved canning and disease resisting kinds from the United States of America. These were submitted to the Victorian Department of Agriculture by the Hon. C. P. Gartside, M.L.C., of Dingley, upon his return from America. Mr. Gartside has made an intensive study of the canning industry both here and abroad and has done much to assist the industry by the introduction of new varieties.

Although it cannot be expected that all new varieties will give satisfaction under Victorian conditions, some are so promising, that they are undoubtedly here to stay. When they become better known and established in the industry, they will be appreciated by those interested in canning, sauce manufacture, and the production of table tomatoes.

For purposes of testing, each variety was distributed in the following districts:—Bendigo, Bairnsdale, East Burwood, Wangaratta, Shepparton, Keilor, Geelong, Bacchus Marsh, Echuca, Koondrook, Mildura, the Mornington Peninsula, and Portland. Although conditions vary in these different parts of the State, the tomato appears to be very cosmopolitan, and a few varieties only proved to be unsuitable in some districts while they appeared to be suitable in others.

Notable examples of this include Orange Prolific, which gives good results in southern Victoria, while in the Murray Valley and other northern areas it is not satisfactory. This variety is a heavy cropper, particularly resistant to disease,

but of poor quality and is a "windbag". Burwood Wonder or South Australian Dwarf yields much better in the northern areas. In some of the coastal districts of the south, the fruit fails to maintain good commercial size after the first or second picking. Bonny Best, Eccles Surprise, Chalk's Early Jewell, Red Marhio, and Crimson Bell are particularly suited to the Bacchus Marsh district. Bonny Best is useless in most other places; softening badly at harvesting period it is not recommended for anywhere other than the above district. Some of the Bendigo strains of Large Red and Yellowtop do exceptionally well in most parts of the State. In addition, most of the cluster types appear to thrive and crop as heavily in the north as in the south.

Preparation of hot-beds and cold frames for the raising of tomato seedlings.

The canning varieties are not usually such heavy croppers as the Chinese or the cluster types. Canning varieties are also excellent table tomatoes and should be grown more extensively in Victoria. Unfortunately, there are really only a few satisfactory varieties, many being shy bearers, prone to "catface" and blossom end rot, particularly if grown too early.

Further, some varieties will not respond to the same treatment as others. The cluster types are not satisfactory unless heavily pruned and staked, and the clusters of fruit thinned as soon as possible after the "sets" have formed. The soil should be heavily impregnated with very old cow or sheep manure, and in addition side-dressed with artificial fertilizers. The flat crinkled types, and some of the smooth round or globe types may be satisfactorily grown either unpruned in the bush form, or pruned and staked in the ordinary way, depending upon the variety and the prevailing conditions. With some varieties, it certainly serves no useful purpose to prune them too heavily, as the fruit reaches normal market size with ordinary methods of good tomato husbandry. To avoid confusion, the cluster types, the smooth round or globe types, and the Chinese or flat crinkled types have been separately tabulated in this article.

GERMINATION AND RIPENING PERIODS OF SOME TOMATO VARIETIES.
(*All Seed Sown on 1st August.*)

Variety.	Germinated.	Pricked Out.	Planted Out.	First Ripe Fruit.	Period from Seed to Maturity.	Approximate percentage of Solids Ratio.	Remarks.
	Aug.	Aug.	Sept.	Dec.	Days.	%	
Kondine Red ..	11th	18th	18th	22nd	144	3·8	Seed not disinfected
Bone's Selected John Baer	11th	18th	18th	23rd	145	4·8	" " "
Mac's Special ..	11th	27th	26th	Jan. 4th	157	3·5	" " "
Maori Chief ..	11th	18th	18th	Dec. 23rd	145	3·2	" " "
Heterosis	20th	27th	26th	30th	152	4·0	Germination delayed 10 days through seed disinfected 1 in 1,000 Mercuric Chloride
Low Branch ..	20th	27th	26th	31st	153	7·2	" " " " "
Red Marhio ..	20th	27th	26th	31st	153	6·2	" " " " "
Coronation ..	11th	18th	18th	Jan. 1st	154	4·0	" " " " "
Eccles' Surprise ..	20th	27th	26th	5th	158	5·2	" " " " "
Sutton	11th	18th	18th	Dec. 23rd	145	3·8	Seed disinfected 1 in 3,000 Mercuric Chloride. Germination not retarded
Burwood Wonder ..	11th	18th	18th	20th	142	3·8	" " " " "

Special Canning Varieties.

All these varieties are of excellent red colour, not watery, non-acid, and excellent for canning or transport purposes :—

Variety.	Seed Sown.	Germinated.	Pricked Out.	Planted Out.	First Ripe Fruit.	Period from Seed to Maturity.	Approximate percentage of Solids Ratio.	Remarks.
	Sept.	Sept.	Oct.	Oct.	Jan.	Days.	%	
Early Shipper ..	15th	25th	2nd	11th	12th	119	5·2	Smooth round, fair cropper, free from "catface." *Recommended*
Scarlet Dawn ..	15th	25th	2nd	11th	19th	126	7·0	Smooth round, good cropper, free from "catface." *Recommended*
Early Baltimore	15th	25th	2nd	11th	23rd	130	6·1	Smooth round flat, good cropper, slightly affected "catface." Suits all soils. *Recommended*
Illinois Baltimore	15th	25th	2nd	11th	29th	136	6·5	Smooth round flat, good cropper, suits all soils. *Recommended*
Prairiana ..	15th	25th	2nd	11th	30th	137	5·2	Smooth round flat, shy cropper, has been produced to suit clay soils of the prairies. Not recommended
Norton's Wilt Resistant	15th	25th	2nd	11th	31st	138	5·2	Too variable in habit. Subject blossom end rot, "catface" &c. Not recommended
Illinois Pride ..	15th	25th	2nd	11th	Feb. 5th	143	5·2	Smooth round slightly flat, fair cropper. Catfaces if grown too early. Better as a late variety. Thrives well in clay soils
Midseason Shipper	15th	25th	2nd	11th	12th	150	5·2	Smooth round, fair cropper. *Recommended* as a late variety
Canner 114 ..	15th	25th	2nd	11th	23rd	161	6·8	Flat, slightly crinkled, but smoother than Australian Large Red or kindred varieties. Only a medium cropper, but flesh is of outstanding quality. Small plantings recommended

An outline of the conditions to which the varieties under test were submitted and points of interest for conditions such as prevail around Melbourne or southern Victoria will be of interest. Southern Victoria, being a late area, no artificial heat was used. The seed was sown very thinly, about 4 or 5 to the inch, in shallow trays, and placed on the north side of a wall in such a manner that an artificial northerly aspect was created permitting the rays of the sun to shine on the little plants from early morning until late afternoon, and at the same time protecting them from the wind.

The trays were covered with glass, which was gradually raised in such a manner as would provide ample ventilation from the time the seedlings appeared above ground. Each night thick hessian covers were placed over the glass to prevent frost converting the seed trays into ice boxes. As the seedlings developed, the glass was removed on sunny days, until about a week before transplanting, when the glass was removed altogether. Soil for the seed trays was composed of three parts of ordinary garden loam, two parts of very old cow manure, and one part of sand. The mixture was prepared about eight months previously.

Under these conditions, the seeds of each variety took exactly ten days to germinate (except dis-

Harvesting tomatoes (Sensation variety) at Portland.

infected seed which was delayed in periods up to another ten days according to the strength of the disinfectant). In another seven days, the first

A prolific crop of tomatoes grown on stakes.

pair of rough leaves appeared and just before that period the seedlings were pricked out about three inches apart into other trays.

After a further thirty days, the eighth leaf had formed, and the young plants, now four to six inches in height and of good sturdy appearance, were planted out very deeply (to the first pair of leaves) in their permanent position. Thus the time from the sowing of the seed until the planting-out stage was approximately seven weeks. During this period, temperatures were observed; these fluctuated from 45° F. on cold evenings to 120° F. in the sunshine (normal conditions for the time of the year).

The plants thrived, and although a few were lost from wilt each variety produced ten leaves before a set of flowers or fruit was formed. This was followed by five leaves and a set of flowers, then three leaves and another set alternately throughout the life of the plant. The periods of development were fairly uniform in all varieties until the first set of flowers was produced, but as fruit formed the inherent character of each variety asserted itself to such an extent that some developed and matured fruit in a comparatively short time, while others were slow and late to mature. From this information, which is tabulated, a grower may distinguish the early from the late varieties.

The seeds from the tomato plants used in this test were sown on the 1st August, 1937, and twelve months later were still producing flowers

Small Cluster Types.

Mostly table varieties, unsuitable for canning. Some are special sauce varieties and unsuitable for the table:—

Variety.	Period from seed to maturity.	Habit of Plant.	Cropping Ability.	Average Size of Fruit.	Quality.	Recommended Method of Pruning.	Remarks.
	Day.						
Principe Borghesi	143	Tall ..	Heavy	Size, shape pullet's egg	Good ..	Single leader on stakes	Sauce variety. Uneven ripening habit. Not as good as San Mazano. Not a table variety.
San Mazano ..	146	Medium	Heavy	Like a large chilli	Good ..	Unpruned on stakes	Probably best variety known for sauce. Not a table variety.
Kondine Red Red	144	Tall ..	Heavy	2″ to 2¼″ ..	Good ..	Single leader on stakes	Excellent table variety. Smooth, round, bright red. Good flavour.
Market King ..	145	Tall ..	Heavy	1¾″ to 2¼″ ..	Good ..	Single leader on stakes	Smooth, round table variety. Fair flavour.
Maori Chief ..	145	Medium	Heavy	2″ to 2¼″ ..	Fair ..	Single leader on stakes	Smooth, round, slightly flattened table variety.
Sutton	145	Medium	Heavy	2″ to 2¼″ ..	Fair ..	Single leader on stakes	Smooth, round, slightly flattened table variety.
Recruit ..	146	Tall ..	Heavy	1¾″ to 2¼″ ..	Good ..	Single leader on stakes	Smooth, round, slightly flattened table variety.
Radio	..	Medium	Heavy	2″ to 2¼″ ..	Good ..	Single leader on stakes	Smooth, round, slightly flattened table variety.
Excelsior ..	..	Tall ..	Heavy	1¾″ to 2¼″ ..	Good ..	Single leader on stakes	Smooth, round table variety.
Early Sunrise ..	..	Tall ..	Heavy	1¾″ to 2¼″ ..	Good ..	Single leader on stakes	Smooth, round table variety.
Heterosis ..	152	Tall ..	Heavy	2″ to 2¼″ ..	Good ..	Single leader on stakes	Smooth, round, slightly flattened table variety.

Special Note.—Few cluster types are satisfactory unless heavily pruned and staked to a single leader. The clusters of fruit should be thinned as soon as possible after it has set. The plant should be stopped after the fourth or fifth "set" and the soil heavily impregnated with very old cow or sheep manure, and, in some instances, additional dressings with artificial fertilizer should be given.

Tomatoes of Outstanding Merit in Victoria.

Ripening periods have been found to vary in different parts of the State. Although those described apply more particularly to southern Victoria they will serve as a guide for other districts :—

Variety.	Approximate percentage of Solids Ratio.	Approximate Period to Maturity from the Seed.	Suggested Method of Growing.
Large Smooth Round Varieties Recommended.	Per cent.	Days.	
Eccles Surprise	5·2	158	Bush form, but preferably lightly pruned on stakes
Red Marhio	6·2	153	Bush form, but preferably lightly pruned on stakes
Low Branch	7·2	153	Bush form, but preferably lightly pruned on stakes
Scarlet Dawn	7·2	126	Bush form, but preferably lightly pruned on stakes
Bone's John Baer	4·8	145	Bush form, but preferably lightly pruned on stakes
Pritchard	7·0	160	Bush form, but preferably lightly pruned on stakes
Crimson Bell	..	..	Bush form only in districts such as Bacchus Marsh
Rutgears	..	..	Unpruned in the bush form
Smaller Cluster Types Recommended.			
*Kondine Red	3·8	144	Heavily pruned; heavily manured; thin the clusters; single leader on stakes
*Market King	3·8	145	Heavily pruned; heavily manured; thin the clusters; single leader on stakes
Recruit	4·0	146	Heavily pruned; heavily manured; thin the clusters; single leader on stakes
Radio	3·4	..	Heavily pruned; heavily manured; thin the clusters; single leader on stakes
Heterosis	4·0	152	Heavily pruned; heavily manured; thin the clusters; single leader on stakes
Brittain's Best	3·6	..	Heavily pruned; heavily manured; thin the clusters; single leader on stakes
Sensation	3·8	..	Heavily pruned; heavily manured; not necessary to thin; single leader on stakes
San Mazano	6·3	146	The whole bush tied up on stakes; not pruned
Flat Wrinkled Types Recommended.			
*South Australian Dwarf	3·8	140	Unpruned and in the bush form
*Burwood Wonder	3·8	140	Unpruned and in the bush form
Mac's Special	3·5	157	Unpruned and in the bush form
Canner 114	7·0	161	Unpruned and in the bush form
*Pale Leaf (Syn. with yellowtop)	3·8	140	Unpruned and in the bush form

Special Notes :—*These varieties are particularly suited for glass house culture.
Varieties showing a low percentage of solids are unsuitable for canning purposes. The high acid ratio of some of the crinkled varieties is also a detriment; their chief virtue is a good cropping habit. It is suggested that each grower gradually increase his production of round-shaped canning varieties as is being done in the Portland district. By degrees, varieties of quality will be discovered that will suit the district.

A test plot of some of the newer canning varieties recently introduced from the United States of America.

and fruit, although slowly. The plants were covered on frosty nights and lightly pruned.

As cold wintry weather approached there was considerable lengthening of the periods of maturity of the fruit, a reduction in its size, and a noticeable alteration in the shape, tending to become more oval. After the middle of April there was a marked absence of disease.

The above remarks are observations of the behaviour of the plants while under test and not a recommendation to try and treat the tomato as a perennial, because after the end of May they could not be considered a commercial proposition. The most suitable period for planting tomatoes in southern Victoria is from about the middle of October until the end of the year. This means that the seed should not be sown until early September.

Outstanding varieties in the above group were Scarlet Dawn, Early Shipper, Midseason Shipper, and Illinois Baltimore. Growers who already have the above varieties are advised to make further small plantings in order that they may benefit if possible when the varieties become acclimatized. It has been observed that all the above varieties maintain their fruit to an excellent marketable size when unpruned and grown in the bush form, but if they are to be staked they should not be pruned too heavily; three to four leaders should be retained with exception of Early Shipper, which also gives satisfactory results if heavily pruned to a single leader. It is readily understood that the solids ratio will vary according to climatic conditions and amount of irrigation given. Growers are therefore strongly advised to use discretion in the watering of tomato plantations, especially for factory purposes.

Tomato seeds are very viable and will germinate after years of storage. At the same time, it is not wise to keep them too long, because the seed coat becomes hardened, and this delays the germinating period several days.

The approximate number of tomato seeds per ounce for different varieties is as follows:—

Variety.	Seeds per Oz.
Burwood Wonder	10,120
Eccles' Surprise	10,700
Crimson Bell	9,810
Market King	11,340
Recruit	9,000
Pritchard	10,025
Rutgers	11,050
Potentate	11,520
Kondine Red	10,840
Red Marhio	10,450
Coronation	10,530

The assistance of many tomato growers in the various districts of the State is gratefully acknowledged, particularly that of the Hon. C. P. Gartside, M.L.C., Messrs. Wm. Bone and Sons, Brighton, Wm. Stuchbury and Son, Portland, and O.T. Plantations Ltd., Dromana.

Butter Production and Export

The following table shows:—

(*a*) Factory production of butter and cheese in Victoria in July, 1938, compared with the corresponding month of 1937.

(*b*) Quantities and percentages of various grades of bulk butter examined in Victoria for export in the months of July and August, 1938, in comparison with the corresponding months of 1937.

FACTORY PRODUCTION OF BUTTER AND CHEESE IN VICTORIA (QUANTITIES IN TONS).

Month.	Butter.		Cheese.	
	1938.	1937.	1938.	1937.
July	2,165 (*)	2,336	289 (*)	259

* Subject to revision.

BULK BUTTER EXAMINED IN VICTORIA FOR EXPORT (QUANTITIES IN TONS).

Month.	1938.					Month.	1937.				
	How Graded—				Total.		How Graded—				Total.
	Ch.	1st.	2nd.	Pty.			Ch.	1st.	2nd.	Pty.	
July	40	53	25	1	119	July	..	7	9	2	18
August	237	90	43	2	372	August	272	84	51	2	409
Totals—2 Months	277	143	68	3	491	Totals—2 Months	272	91	60	4	427
Percentages	56·4	29·1	13·9	0·6	..	Percentages	63.7	21·3	14·0	1·0	..

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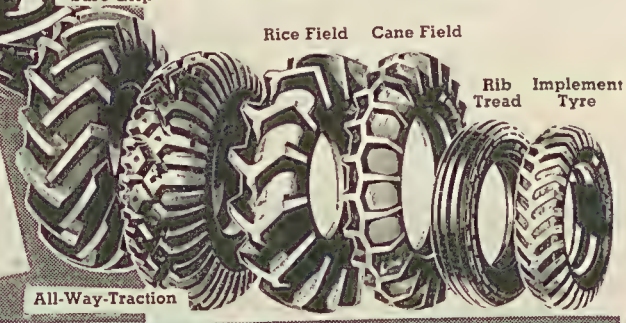

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The Carpet Beetle

(*Anthrenus varius Lea*)

By R. T. M. Pescott, M.Agr.Sc., Entomologist.

OF the several insects which may be found attacking furnishings and clothing in the home or in warehouses and shops, Carpet Beetles (*Anthrenus varius Lea*) are probably the most numerous and, during the summer months particularly, may be responsible for quite severe damage to these materials. As the name implies, carpets are the main items affected by this insect, but actually all products of animal origin, particularly those containing wool, are prone to attack. In this regard, house furnishings and clothing containing wool, furs, feathers, bristles, and hair are especially susceptible. These insects are recorded also as being able to subsist for some time upon floury or starchy materials. but are not destructive pests to timber or the woodwork of furniture, although they may at times be found sheltering in such places. The grubs of the insect are frequently confused with those of the well known clothes moths, but the distinctive little hairy larvæ (see Fig. 1) will serve to establish their identity.

The losses by this insect are caused by the feeding activities of the larvae or grubs. On carpets, the damage is chiefly restricted to complete destruction, in more or less small areas, of the pile of the carpet, while the foundation, usually of some vegetable matter, is not touched. With woollen articles of clothing, holes may appear.

Fig. 1.—The edge of a wool carpet being eaten by larvæ of the carpet beetle. Note that the larvæ are eating the woollen pile only. U.S.D.A.

Fig. 2.—The adult carpet beetle.

Life History.

The carpet beetle undergoes four stages in its development—adult, egg, larva or grub, and pupa. The adult is a small beetle, shaped not unlike a ladybird, but measuring only one eighth of an inch in length (see Fig. 2). In colour it is a marble brown and grey, though on some specimens black patches may be seen where the coloured scales have been rubbed off. The adult beetles fly readily, are attracted to light and are frequently to be found on curtains and window ledges. During the spring and summer months they may occasionally be found in white flowers in the garden, the plant Star of Bethlehem (*Ornithogalum*) being particularly favoured. In the city areas, it is certain that

Fig. 3.—A larva or grub of the carpet beetle.

infection of a house previously free from this pest can occur by beetles flying in from neighbouring houses.

The female beetle lays up to one hundred eggs which are usually placed in sheltered protected places, such as cracks in floors, behind skirting boards, in the pile of carpets, &c. These eggs hatch in from seven to eighteen days, depending on the time of the year in which they were laid. The young larvae or grubs hatching from these eggs commence feeding at once and continue feeding for a period of about three months in the summer, at the end of which they are fully grown, being then small grubs of about three sixteenths of an inch in length, of a dark brown colour, with lighter stripes between the segments. They undergo a series of about six or eight moults or shedding of the skin during their growth. When mature these larvae pupate within the last larval skin, finally emerging as adults. In Victoria there are usually two generations a season.

It is well to remember that it is only while in the larval or grub stage that this insect is injurious, and that they prefer to work in semi-darkened places, shunning the light. Such places as the edges of carpets, underneath pianos, and in the felt of pianos are always favoured situations.

Control.

Once the carpet beetle is well established, only regular applications of one or more of the following control measures will remove the trouble.

Carpet damage.—In the home, the increase of this pest is considerably hastened by the fashion of laying the carpet from wall to wall. If the carpet extends only to 12 inches or so from the walls the edges can be cleaned frequently and any carpet moth larvae removed during the process. However, where carpets are tacked down adjacent to walls, considerable damage may result in corners before the presence of the insect is noticed. As soon as any such damage is noted, these areas should be soaked with one of the recognized pyrethrum fly sprays, and the carpet lifted and given a thorough vacuum cleaning, top and bottom.

When intending to store carpets or rugs they should be thoroughly cleaned on both sides first, well covered with paradichlorbenzene or naphthalene, rolled tightly and then wrapped in several thicknesses of brown paper with the ends sealed.

Furniture.—Where the upholstering of furniture is attacked, a measure of success can be obtained

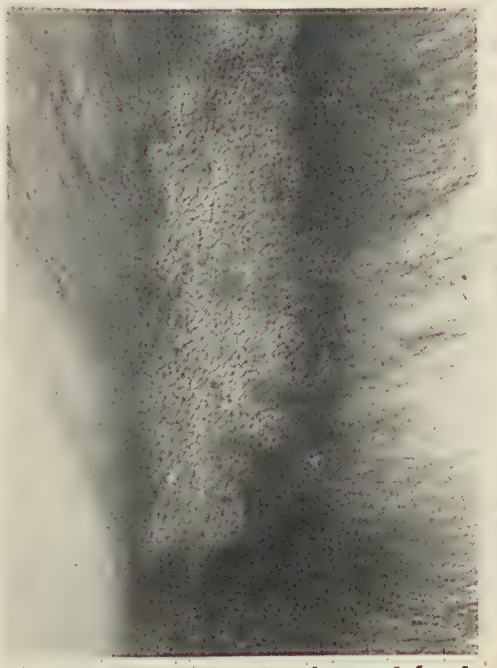

Fig. 4.—Portion of a fur damaged by the carpet beetle.

[*Continued on page* 483.

Feeding Poultry for Egg Production

By H. F. Clinton, Poultry Expert.

A HIGH yield of first quality eggs is the result of systematic culling and breeding from suitable birds, a comfortable healthy environment, and correct feeding. The food that a laying fowl eats has several important functions to fulfil. Firstly, it is the crude material from which the body forms new cell tissue and body fluids to replace those used up during the daily routine of life. Secondly, it supplies the energy by which the body performs work and keeps its temperature uniform. Lastly, it forms the raw material from which the bird manufactures a product such as eggs.

Many different rations have been suggested for the feeding of poultry throughout the world, and special claims have been made that one particular ration is better than another, but it has been shown in feeding experiments and on commercial poultry farms that fowls will lay well when fed on many different kinds of foods. From the viewpoint of economy, however, which must be observed on every poultry farm, if success is to be assured, it is essential that the ration should consist of a suitable variety of foods of good quality, properly balanced, and that the cost be reduced as much as possible.

It is necessary to feed a variety of foods in order to increase palatability and to maintain bodily health. If palatability is increased the consumption of food is increased, and this, therefore, increases the production of eggs, for it is only the food left after the maintenance demand is satisfied that is available for this purpose. It has been found that some foods contain certain essential constituents necessary for the maintenance of health while they are deficient in other foods. This may be provided for by a combination of foods properly chosen.

A ration that is properly balanced is one that furnishes the necessary constituents in such amounts and proportions as are necessary to maintain the bird in good health and for high egg production. It should contain sufficient digestible complete proteins (for repair of bodily tissue, &c.), and digestible energy-producing substances (such as starch, fat, sugar) in the right proportions. It should contain the vitamins, and the right kind of mineral matter in adequate amounts, and be free from injurious substances, such as poisons, especially cumulative poisons, disease germs or anything that produces mechanical injury.

The foods fed to poultry consist chiefly of cereals, cereal by-products, green foods, and by-products of plant and animal origin. A very high percentage of protein is contained in meat

meal and dried butter-milk, &c., while such foods as cereals are much lower in protein but contain a high percentage of starch.

The following rations, suitable for egg production, are suggested by the Department of Agriculture :—Bran, 30 lb. ; wheat-pollard, 50 lb. ; maize-meal, oat-pollard, or barley-meal, 10 lb. ; meat-meal or dried butter-milk, 10 lb. (or 5 lb. of meat-meal, and 5 lb. of dried butter-milk) ; total, 100 lb. These foods are mixed together and fed as a dry mash in hoppers kept continually before the birds. In the dry mash system of feeding, chaffed green food is fed separately. This formula can also be used as a wet mash, which may be mixed as follows :—The bran and meat-meal are mixed together, then moistened with the liquid to be used, dried off with the pollard and other fine meals, and approximately 25 per cent. of chaffed green food is then added, the whole being formed into a nice crumbly mash. This is fed regularly each morning in clean troughs. Some chaffed green food may also be fed separately. If cooked meat, such as bullocks' heads, livers, &c., be used in place of meat-meal or dried butter-milk, the mash should be mixed with the soup. A little less than one-third of an ounce of the cooked meat should be allowed per bird per day, or approximately 2 oz. per week. The grain ration is fed in the litter in the evening in the following proportions, and this can be used for either the wet or dry mash system :—Wheat, 60 lb. ; oats or barley, 20 lb. ; maize, 20 lb. ; total, 100 lb. Table salt may be added to either the wet or dry mash in the proportion of ½ lb. to 1 lb. for every 100 lb. of mash, weighed dry. This amount should not be exceeded, and care should be taken to allow for any salt that is present in other ingredients of the ration. The kind of fine salt sold for stock purposes is cheaper than the household variety. The salt should be thoroughly mixed through the dry mash, and for the wet mash it should be properly dissolved in the liquid or soup with which the mash is to be made, to ensure an even distribution.

The question is frequently raised whether the dry mash or wet mash system is the better for egg production. Each system has proved highly satisfactory in official egg-laying competitions and on commercial poultry farms. Some of the larger farms, however, feed wet mash when fresh meat, &c., can be purchased in a large way. There is no doubt that a good wet mash, well mixed, is very palatable. On the other hand, the dry mash system saves an enormous amount of labour, and it is a very simple and clean method of feeding. Sometimes both systems have been used together, under certain circumstances, as a change of food or in order to increase the amount of food eaten.

The value of fresh, succulent green food for poultry can hardly be exaggerated ; it is, indeed, a most important necessity on every poultry farm, and a continuous and varied supply must be provided if good health of the birds is to be maintained. This may be supplied at midday or after the grain ration at night. A regular, plentiful supply of fresh greens is the common method of supplying vitamin A, the growth promotion vitamin to poultry. Not less than 5 to 6 lb. of chaffed green food should be provided for every 100 adult birds daily. Green food

This team of Australorps, which laid 1,522 eggs in a recent egg-laying competition, was fed on a wet mash diet.

should be fed only when young, as fibre is practically indigestible to poultry. The kinds of green foods that may be given are many and some of the best are: barley, oats, maize, silver beet, rape, mustard, lucerne, berseem, lettuce, millet, grass, chou moellier, cabbage and cauliflower leaves. Minced raw onions are also most suitable for poultry, when available at a reasonable price, and are greatly relished by the birds. Approximately ¾ oz. can be fed to each adult bird twice a week.

Granulated charcoal and shell grit should always be available, and a liberal supply of pure cool drinking water should be kept constantly before the birds. Strict cleanliness in the use of food and water vessels is essential in order to keep the birds in perfect health.

The amount of food that should be supplied to each bird daily has to be determined by experience, as no hard and fast rule can be laid down. For egg production it is advisable to give the birds as much as they will comfortably eat without waste. The amount varies according to the time of the year, and more food is eaten during the period of high egg production than during the period of low production.

The public demand is for good flavoured eggs with a richly-coloured yolk. If the foods used consist chiefly of wheat, oats, barley, and milk products, the yolk will be of a pale yellowish or whitish colour, whereas if foods such as green foods, yellow maize, &c., are fed in addition, the yolk will be of a rich yellow or orange. It should be observed that some kinds of green foods, when fed in excess, give rise to yolks of an olive tint, and certain other foods give rise to yolks of an undesirable colour or with darkish spots.

In addition to the foods previously mentioned, other suitable foods may be included in a ration, in addition or as a substitute for one or portion of the other ingredients, when they can be purchased at a reasonable price. In special cases it may be necessary to advise the ad lition of certain specific foods or a mineral mixture.

All foods should be of good quality, and stored in vermin-proof receptacles. Such foods as meat-meal, dried butter-milk, and proprietary foods come under the provisions of the Stock Foods Act, and poultrymen should see that they bear a label, stating the name of the material, the name and address of the manufacturer, and the guaranteed analysis as regards protein, fat, and fibre. Supplies in original containers should not be accepted unless so labelled.

Finally, poultry-farmers are once again reminded that they may receive assistance and guidance when in any difficulty by applying to the Departmental Poultry Expert, or to the Chemist for Agriculture for information on scientific aspects of feeding or on the composition of any particular feeding stuff.

The Carpet Beetle *continued from page 480.*

by the use of constant sprayings with a pyrethrum fly spray, but if it is found that the infestation is severe, it is advisable to have this article of furniture taken away and thoroughly fumigated by a fumigating firm.

Sprays.

Any of the ordinary pyrethrum fly sprays so common on the market nowadays are excellent materials for spraying flooring, skirting boards or any such places where the grubs of this insect may be hiding. This type of spray is best applied under strong pressure and as only those insects actually hit with the spray are killed, it is obvious that it is essential that this treatment be repeated several times.

Naphthalene and paradichlorbenzene possess very valuable powers of killing carpet beetles and their grubs, when the activities of the insects are confined to more or less closed or restricted spaces. Where clothes or furnishings are stored in trunks or cupboards, these materials should be used at the rate of roughly one pound of material for every one hundred cubic feet of space, and the material distributed preferably on paper at various heights in the cupboard or trunk.

Fumigation.

Where a whole house or a warehouse or shop is uniformly and severely affected, very successful control of this insect can be obtained by the fumigation of the whole property with hydrocyanic acid gas. As this gas is a deadly poison, any attempt at fumigating such a building should be left strictly in the hands of an experienced fumigator.

In general, however, providing that the infestation in a house is small only, it is not necessary to resort to fumigation, and satisfactory control can be obtained by one or more of the other methods mentioned.

London Markets

Weekly Prices

The following information as to prices offering in London for the principal Victorian primary products has been taken from cablegrams received each week by the Department of Agriculture from the Victorian Agent-General in London.

Product.		Price for Week Ending—				
		2nd Sept.	9th Sept.	16th Sept.	23rd Sept.	30th Sept.
		d.	*d.*	*d.*	*d.*	*d.*
Lamb, 1st quality, Victorian	29–36 lb.	..	..	..	..	..
Lamb, 1st quality, Victorian	37–42 lb.	..	..	..	..	..
Lamb, 1st quality, other States	29–36 lb.	..	..	..	..	..
Lamb, 1st quality, other States	37–42 lb.	..	..	..	..	..
Lamb, 2nd quality, Victorian	28 lb. and under	7	7	6⅞	7	..
Lamb, 2nd quality, Victorian	29–36 lb.	..	..	..	..	..
Lamb, 2nd quality, other States	28 lb. and under	7	7	6⅞	6⅞	..
Lamb, 2nd quality, other States	29–36 lb.	..	..	..	..	..
Lamb, 3rd quality, all States	28 lb. and under	6⅞	6⅞	6¾	6⅝	6¾
Lamb, 3rd quality, all States	29 lb. and over	..	..	..	..	..
Mutton wethers and/or maiden ewes	Under 40 lb.	4	4	4	4	4
Mutton wethers and/or maiden ewes	41–48 lb.	3⅜	3⅜	3⅜	3⅜	3⅜
Mutton wethers and/or maiden ewes	49–56 lb.	..	..	..	..	..
Mutton ewes	Under 40 lb.	4	4	4	3⅞	3⅞
Mutton ewes	41–48 lb.	3¼	3¼	3¼	3¼	3¼
Beef, frozen ox hinds	145–210 lb.	..	..	..	4⅛	4⅛
Beef, frozen ox crops, weights corresponding	..	..	..	..	3⅜	3⅜
Beef, chilled ox hinds	145–210 lb.	5½	5½	5½	5	5⅛
Beef, chilled ox crops, weights corresponding	..	3¾	3⅝	3⅜	3⅛	3¼
Pork, Australian 1st quality	60–80 lb.	6⅞	6⅞	7	7⅛	7¼
Pork, Australian 1st quality	81–100 lb.	6⅝	6⅝	6¾	6⅞	7
Pork, New Zealand, 1st quality	60–80 lb.	6⅞	6⅞	7	7⅛	7¼
Pork, New Zealand, 1st quality	81–100 lb.	6⅝	6⅝	6¾	6⅞	7
		s.	*s.*	*s.*	*s.*	*s.*
Bacon, Canadian	per cwt.	92	93	93	93	93
Bacon, Empire (cured in England)	per cwt.	89	89	89	89	89
Bacon, Danish	per cwt.	99	99	99	99	99
Butter, unsalted, choicest grade	per cwt.	119–120	120–121	116–117	110–111	116
Butter, unsalted, 1st grade	per cwt.	118–119	118–119	..	..	114
Butter, unsalted, 2nd grade	per cwt.	..	..	..	..	..
Butter, unsalted, pastry grade	per cwt.	..	..	..	..	..
Butter, salted, choicest grade	per cwt.	118–120	119–120	114–116	108–111	114
Butter, salted, 1st grade	per cwt.	117–119	118–119	114–115	107–109	112
Butter, salted, 2nd grade	per cwt.	115–116	116–117	113–114	106–108	110
Butter, salted, pastry grade	per cwt.	111	112–113	110	102–104	106
Butter, Danish	per cwt.	133	133	133	133	136
Market (butter)		Firm through week, prices higher towards close	Slow	Slow	Slow and irregular	——

Burnley Egg-Laying Competition

Results of Winter Tests

By H. F. Clinton, Poultry Expert.

THE twenty-eighth Burnley Egg-laying Competition commenced on the 1st April, 1938, and will continue until 2nd March, 1939, a period of 48 weeks. The winter test conducted in connexion with this competition covers only the first four months (122 days) and concluded on 31st July. For this period of the present competition, it was decided to award certificates for the greatest number of first-grade eggs laid by teams and individual birds in all classes of the competition, instead of to light and heavy breeds only irrespective of class, as was done previously. During the first two months of the competition a first-grade egg must weigh not less than $1\frac{3}{4}$ oz., and thereafter during the remainder of the competition not less than 2 oz.

The object of the winter test is to give prominence to those birds that have laid well during this period of the year, when prices received for eggs are high. It has been generally considered that egg production on commercial poultry farms could be considerably improved by breeding from birds that have laid a reasonable number of eggs during the autumn and winter months, in addition to having laid well during the remainder of the competition.

A high producing bird of good type and constitution.

Some splendid scores were recorded, both by teams and individual birds, and a new record was established for teams of light breeds. Several well known breeders have been successful again this year. For the first time in this competition a special section was provided for members of Young Farmers' Clubs. Although the number of entries received in this section was small, it is expected that greater interest will be taken by members next year.

Teams of Six.

In Section A, Class 1, White Leghorns, Wet Mash, Mr. F. W. Becker won first prize with a team that laid a highly creditable total of 589 eggs, all first grade. This is the highest score recorded in Section A, and also constitutes a record at Burnley in the winter test for light breeds, the previous highest score being in 1914–15 when a team of White Leghorns laid 565 eggs. A bird in Mr. Becker's team laid 105 eggs, all first grade, equalling the highest number of first-grade eggs laid by any individual bird in the competition. Equal second prizes were awarded to Messrs. H. I. Jolly and C. and D. McLauchlan with teams that laid 467 eggs each.

In Class 2, White Leghorns, Dry Mash, first prize went to Molson's White Leghorn Stud (W. E. Molson) with a team that laid 345 first-grade

eggs. Mr. J. M. Sutherland was a close second, his team having laid 338 eggs, while Mr. C. R. Fagg's team secured third prize with 304 eggs. A bird in a team of White Leghorns entered in this class by Mr. M. G. Skinner laid 85 first-grade eggs.

In the class for all light breeds other than White Leghorns, first prize was awarded to a team of Brown Leghorns, owned by Mr. F. R. Vincent, that laid 194 first-grade eggs. A bird in this team laid 63 first-grade eggs. Carlella Poultry Farm (J. W. Stoneman) won second prize with a team of Brown Leghorns that laid 128 eggs. Mr. J. Herbert won first prize in the section for Australorps with a team that laid a total of 570 first-grade eggs—the second highest score recorded in Section A. Mr. W. A. Shevill was awarded second prize for a team that laid 504 eggs, and Mr. W. Cullen's team secured third prize with 481 eggs. A bird in a team of Australorps owned by Messrs. D. and J. Tresise laid 105 first-grade eggs, equalling the highest total number of first-grade eggs laid by any individual bird in the competition.

In Class 5, Rhode Island Reds, Pine View Poultry Farm (R. G. Willmott) was awarded first prize for a team that laid 364 first-grade eggs. A bird in this team laid 86 first-grade eggs. Mr. S. N. Lloyd gained second prize with a team that laid 352 eggs, and Mr. W. Tedstone obtained third prize with 305 eggs.

Individual Birds.

In the section for White Leghorns, fed on wet mash, first and second prizes were won by Mr. T. L. Eastaugh with birds that laid 103 and 100 first-grade eggs respectively, while Mr. J. A. Stewart followed closely with third prize, one of his birds having laid 98 eggs. In the White Leghorn class, fed on dry mash, first prize was won by Mr. M. G. Skinner with a bird that laid 94 first-grade eggs. Mr. H. I. Jolly's bird was second with 88 eggs, and Mr. G. E. Thomas secured third prize with only one egg less.

First prize in Class 3, i.e., all light breeds other than White Leghorns, was awarded for a Brown Leghorn, owned by Mr. D. Granter, that laid 75 first-grade eggs. Brown Leghorns owned by the Carlella Poultry Farm (J. W. Stoneman) and Mr. J. Granter won second and third prizes with 56 and 48 eggs respectively. In the class for Australorps, first prize was won by Mr. P. Phelan with a bird that laid 104 first-grade eggs—the second highest number of first-grade eggs laid by any individual bird in the competition. Mr. Phelan also shared equal second prize with Mr. J. Grass with birds that laid 102 eggs each.

Mr. R. Farrin-Webb obtained first prize in the section for Rhode Islands with a Rhode Island Red that laid 93 first-grade eggs. Mr. J. Rankin secured second prize with a Rhode Island Red that laid 84 eggs, and Mr. J. Chatts followed closely for third prize with a bird of the same breed that laid 83 eggs—only one egg less. In the section for all heavy breeds other than Australorps and Rhode Islands, Messrs. C. and D. McLauchlan won first prize with a Light Sussex that laid 105 first-grade eggs—also equalling the highest number of first-grade eggs laid by any individual bird in the competition. Mr. H. R. Cropley's Light Sussex entries secured equal second prizes, each of his birds having laid 89 eggs.

In the Young Farmers' Club Section Miss Marjorie Parker won first and second prizes with Australorps that laid 95 and 73 first-grade eggs respectively. Miss Flora Rhodes gained third prize with an Australorp that laid 66 eggs.

A summary of the leading scores is shown in the accompanying table.

SECTION A.—TEAMS OF SIX BIRDS, TRAP-NESTED.

Pen No.	Name and Address.	Total Eggs.	Under-weight.	First Grade Eggs.
	Class 1.—White Leghorns—Wet Mash.			
	First Prize—Champion Certificate.			
2	F. W. Becker, 103 Clarence-street, Geelong West	589	..	589
	Equal Second Prize—Government Certificate.			
7	H. I. Jolly, Ace P. Farm, Nelson-road, Trafalgar	467	..	467
	Equal Second Prize—Government Certificate.			
10	C. and D. McLauchlan, 144 Through-road, Burwood	469	2	467
	Class 2.—White Leghorns—Dry Mash.			
	First Prize—Champion Certificate.			
34	Molson's White Leghorn Stud (W. E. Molson), 188 Surrey-road, Blackburn	348	3	345
	Second Prize—Government Certificate.			
37	J. M. Sutherland, Fulton-road, Box Hill	340	2	338
	Third Prize—Government Certificate.			
32	C. R. Fagg, 76 Maud-street, Geelong	311	7	304

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Section A.—Teams of six birds—Trapnested.—*continued.*

Pen No.	Name and Address.	Total Eggs.	Under-weight.	First Grade Eggs.
	Class 3.—All Light Breeds other than White Leghorns—Wet Mash.			
	First Prize—Champion Certificate.			
29	F. R. Vincent, Melbourne-road, Frankston (Brown Leghorn)	207	13	194
	Second Prize—Government Certificate.			
28	Carlella Poultry Farm (J. W. Stoneman), Campbell-street, Briar Hill (Brown Leghorn)	128	..	128
	Class 4.—Australorps—Wet Mash.			
	First Prize—Champion Certificate.			
57	J. Herbert, 13 Dunn-street, Wonthaggi	576	6	570
	Second Prize—Government Certificate.			
66	W. A. Shevill, 35 Bourke-street, Mentone, S.11	520	16	504
	Third Prize—Government Certificate.			
53	W. Cullen, Werribee Poultry Farm, Werribee	488	7	481
	Class 5.—Rhode Island Reds—Wet Mash.			
	First Prize—Champion Certificate.			
42	Pine View Poultry Farm (R. Willmott), 3 Monteath-avenue, Hawthorn, E.3	365	1	364
	Second Prize—Government Certificate.			
41	S. N. Lloyd, Cranbourne-road, Frankston	355	3	352
	Third Prize—Government Certificate.			
44	W. Tedstone, 243 White-horse-road, Balwyn, E.8	305	..	305

SECTION B.—INDIVIDUAL BIRDS, SINGLE TEST.

Pen No.	Name and Address.	Total Eggs.	Under-weight.	First Grade Eggs.
	Class 1.—White Leghorns—Wet Mash.			
	First Prize—Champion Certificate.			
21	T. L. Eastaugh, Point Nepean-road, Highett, S.21	103	..	103
	Second Prize—Government Certificate.			
22	T. L. Eastaugh, Point Nepean-road, Highett, S.21	100	..	100
	Third Prize—Government Certificate.			
80	J. A. Stewart, Maldon-road, Castlemaine	100	2	98

Section B.—Individual Birds, Single Test.—*continued.*

Pen No.	Name and Address.	Total Eggs.	Under-weight.	First Grade Eggs.
	Class 2.—White Leghorns—Dry Mash.			
	First Prize—Champion Certificate.			
219	M. G. Skinner, 75 Vincent-street, Sandringham, S.8	95	1	94
	Second Prize—Government Certificate.			
207	H. I. Jolly, Ace Poultry Farm, Nelson-road, Trafalgar	88	..	88
	Third Prize—Government Certificate.			
221	G. E. Thomas, "Rosanna", Chesterville-road, Cheltenham, S.22	87	..	87
	Class 3.—All Light Breeds other than White Leghorns—Wet Mash.			
	First Prize—Champion Certificate.			
199	D. Granter, 163 Martin-street, Gardenvale, S.4 (Brown Leghorn)	75	..	75
	Second Prize—Government Certificate.			
198	Carlella Poultry Farm (J. W. Stoneman), Campbell-street, Briar Hill (Brown Leghorn)	56	..	56
	Third Prize—Government Certificate.			
202	J. Granter, 163 Martin-street, Gardenvale, S.4 (Brown Leghorn)	49	1	48
	Class 4.—Australorps—Wet Mash.			
	First Prize—Champion Certificate.			
133	P. Phelan, 11 Traill-street, Northcote, N.16	106	2	104
	Equal Second Prize—Government Certificate.			
134	P. Phelan, 11 Traill-street, Northcote, N.16	105	3	102
	Equal Second Prize—Government Certificate.			
117	J. Grass, 44 Station-street, Burwood	102	..	102
	Class 5.—Rhode Islands—Wet Mash.			
	First Prize—Champion Certificate.			
166	R. Farrin-Webb, "Rafa", Traralgon (Rhode Island Red)	93	..	93
	Second Prize—Government Certificate.			
176	J. Rankin, 14 Freeman-street, Balwyn (Rhode Island Red)	87	3	84
	Third Prize—Government Certificate.			
161	J. Chatts, White-street, Beaumaris, S.10 (Rhode Island Red)	83	..	83

Section B.—Individual Birds, Single Test.—*continued.*

Pen No.	Name and Address.	Total Eggs.	Under-weight.	First Grade Eggs.
Class 5.—All Heavy Breeds other than Australorps and Rhode Islands—Wet Mash.				
First Prize—Champion Certificate.				
193	C. and D. McLauchlan, 144 Through-road, Burwood, E.13 (Light Sussex)	106	1	105
Equal Second Prize—Government Certificate.				
191	H. R. Cropley, Boronia-road, Bayswater (Light Sussex)	89	..	89
Equal Second Prize—Government Certificate.				
192	H. R. Cropley, Boronia-road, Bayswater (Light Sussex)	89	..	89

YOUNG FARMERS' CLUB SECTION.

Pen No.	Name and Address.	Total Eggs.	Under-weight.	First Grade Eggs.
First Prize—Champion Certificate.				
156	Miss Marjorie Parker, Mickleham (Australorp)	95	..	95
Second Prize—Government Certificate.				
155	Miss Marjorie Parker, Mickleham (Australorp)	74	1	73
Third Prize—Government Certificate.				
158	Miss Flora Rhodes, Mickleham (Australorp)	66	..	66

SECTION A.—FOR THE GREATEST NUMBER OF FIRST GRADE EGGS LAID BY INDIVIDUAL BIRDS IN EACH CLASS OF SECTION A.

Pen No.	Name and Address.	Bird No.	Total Eggs.	Under-weight.	First Grade Eggs.
Class 1.—White Leghorns—Wet Mash.					
First Prize—Champion Certificate.					
2	F. W. Becker, 103 Clarence-street, Geelong West	9	105	..	105
Second Prize—Government Certificate.					
2	F. W. Becker, 103 Clarence-street, Geelong West	11	102	..	102
Equal Third Prize—Government Certificate.					
2	F. W. Becker, 103 Clarence-street, Geelong West	7	100	..	100
Equal Third Prize—Government Certificate.					
10	C. and D. McLauchlan, 144 Through-road, Burwood, E.13	55	100	..	100

Section A.—First Grade Eggs by Individual Birds—*continued.*

Pen No.	Name and Address.	Bird No.	Total Eggs.	Under-weight.	First Grade Eggs.
Class 2.—White Leghorns—Dry Mash.					
First Prize—Champion Certificate.					
35	M. G. Skinner, 75 Vincent-street, Sandringham, S.8	207	87	2	85
Equal Second Prize—Government Certificate.					
34	Molson's White Leghorn Stud (W. E. Molson) 188 Surrey-road, Blackburn	200	83	1	82
Equal Second Prize, Government Certificate.					
37	J. M. Sutherland, Fulton-road, Box Hill	221	82	..	82
Equal Second Prize—Government Certificate.					
32	C. R. Fagg, 76 Maud-street, Geelong	190	83	1	82
Class 3.—All Light Breeds other than White Leghorns—Wet Mash.					
First Prize, Champion Certificate.					
29	F. R. Vincent, Melbourne-road, Frankston (Brown Leghorn)	169	65	2	63
Second Prize—Government Certificate.					
29	F. R. Vincent, Melbourne-road Frankston (Brown Leghorn)	170	60	..	60
Third Prize—Government Certificate.					
28	Carlella Poultry Farm (J. W. Stoneman), Campbell-street, Briar Hill (Brown Leghorn)	165	57	..	57
Class 4.—Australorps—Wet Mash.					
First Prize—Champion Certificate.					
70	D. and J. Tresise, Serpentine	417	105	..	105
Second Prize—Government Certificate.					
57	J. Herbert, 13 Dunn-street, Wonthaggi	341	102	..	102
Third Prize—Government Certificate.					
53	W. Cullen, Werribee Poultry Farm, Werribee	314	102	1	101
Class 5.—Rhode Islands—Wet Mash.					
First Prize—Champion Certificate.					
42	Pine View Poultry Farm (R. Willmott), 3 Monteath-avenue Hawthorn East, E.3	250	86	..	86
Second Prize—Government Certificate.					
42	Pine View Poultry Farm (R. Willmott), 3 Monteath-avenue, Hawthorn East, E.3	247	84	..	84
Third Prize—Government Certificate.					
44	W. Tedstone, 243 Whitehorse-road, Balwyn, E.8	260	82	..	82

A Victorian packing house and cool store.

Shrinkage in Jonathan Apples During Cool Storage

By G. B. Tindale, B.Agr.Sc., Cool Storage Research Officer, and B. P. Krone, Fruit Packing Instructor.

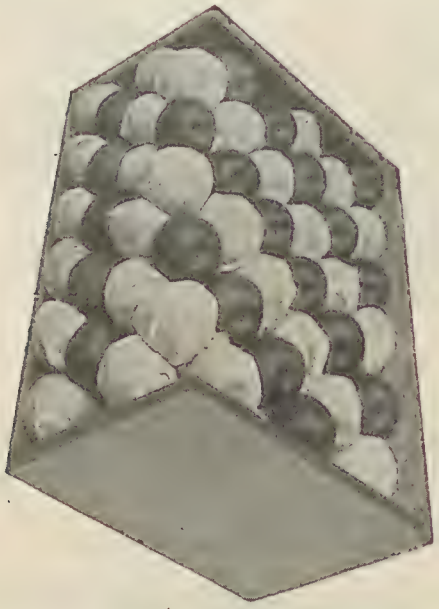
FROM time to time rather scathing reports are received from overseas regarding the slack packing of Victorian apples. Sometimes it is reported that the packing is so slack, that, in order to properly fill the case, another layer of apples could be added. When the matter has been brought under the notice of the growers concerned, they usually are quite emphatic that their packing was not at fault, and they consider that the slackness must have been due to shrinkage during cooling and transport.

In order that growers and the trade generally might have some guidance as to the actual shrinkage and loss of weight that occur in properly packed apples during storage, an experiment was conducted on the following lines:—During the morning of 22nd March, 1938, 21 cases of Jonathan apples were picked, carefully wrapped and packed at Blackburn where they were grown. The apples were packed into the ordinary dump case (internal measurements 18″ x 8⅔″ x 14¼″) and handled as though intended for export. The boxes were weighed before and after packing and the actual weight of apples obtained. The following day the apples were conveyed by motor truck to the Government Cool Stores, Melbourne, for cool storage. Prior to cool storage, however, they were subjected to various periods of delay at the controlled temperatures of 65°, 55° and 45° F. The object of this was to imitate export conditions, for when apples are exported there is always a period of delay (the length of which may vary enormously) between packing and cooling in the ship's hold. (Apples unlike pears are not precooled awaiting shipment). For the experiment, using one case as a unit, apples were held at 65° F. for 2, 4, 6, 8, 10, 12 and 14 days, at 55° F. for 3, 6, 9, 12, 15, 18 and 21 days and at 45° F. for 4, 8, 12, 16, 20, 24 and 28 days, after which they were all placed in cool storage at 32°. They remained in cool storage until 23rd May when they were withdrawn and examined for shrinkage and loss of weight. This period in cool storage would approximate to the usual shipping period.

The accompanying table sets out the count, size, and pack, of each case, the storage treatment given, the actual weight of apples on packing and after storage, the loss of weight of apples (expressed also as number of apples "lost") and the condition of the pack after storage.

From the table it will be seen that there was an appreciable loss of weight of apples during storage. There was less loss of weight where the delay prior to storage occurred at the lowest temperature. The average loss of weight where the delay occurred at 45° F. amounted to 14 oz., whereas where the delay occurred at 55° F. and 65° F. the loss averaged 1 lb. 4 oz. Should the

delay at 65° F. have been prolonged to 28 days, i.e., the maximum at 45° F., then no doubt a much greater difference would have been noted.



Apples packed in the Australian dump bushel case.

Nevertheless in spite of the loss of weight as recorded, it was not sufficient to result in slackness of pack. In nearly all instances the cases were still quite full. In a few instances a slight slackness had occurred, but even then it did not exceed a space of $\frac{1}{4}''$ at the top of the case. Even this, however, was scarcely noticeable, and was not sufficient cause for complaint on the part of a buyer.

It should be particularly observed that, in spite of a popular idea that the Jonathan being a light apple will not pack 40 lb. to the bushel dump case without bruising, the lowest weight packed per case was 41 lb. 7 oz. and the highest 47 lb. 4ozs,. the average being 44 lb. 12 oz. with a noticeable absence of bruising. Allowing for the maximum loss of weight of 1 lb. 12 oz., the weight of apple which a buyer overseas should obtain in a properly packed line of Jonathans shipped in the ordinary way should be in the region of 43 lb., which is considerably in excess of the desired 40 lb.

Where complaints are received from overseas stating that the boxes are holding anything from 3 to 5 lb. under the 40 lb., then it seems obvious that not sufficient weight of apples was packed into the case in the first instance. Although it is easier to pack full a case of Jonathans weighing less than 40 lb. than it is to pack full ones weighing

LOSS IN WEIGHT OF JONATHAN APPLES DURING COOL STORAGE.

Count.	Size.	Pack.	Layer.	Storage Treatment.	Weight of Apples after Packing.	Weight of Apples after Storage.	Loss of Weight after Storage.	Loss of Weight expressed as Number of Apples.	Condition of Pack after Storage.
	inch				lb. oz.	lb. oz.	lb. oz.		
263	2¼	3–2	8 x 7	4 days at 45° thence at 32°	46 6	45 6	1 0	6	No appreciable slackness
193	2½	3–2	6 x 5	8 „ 45° „ 32°	44 15	44 6	0 9	2	Very slightly slack
175	2½	3–2	5 x 5	12 „ 45° „ 32°	42 9	41 7	1 2	5	„ „
228	2¼	3–2	7 x 6	16 „ 45° „ 32°	45 4	44 8	0 12	4	No appreciable slackness
144	2¾	2–2	6 x 6	20 „ 45° „ 32°	45 1	44 3	0 14	3	„ „
245	2¼	3–2	7 x 7	24 „ 45° „ 32°	47 4	46 8	0 12	4	„ „
245	2¼	3–2	7 x 7	28 „ 45° „ 32°	47 2	45 14	1 4	6	„ „
228	2¼	3–2	7 x 6	3 „ 55° „ 32°	44 4	43 12	0 8	2	„ „
228	2¼	3–2	7 x 6	6 „ 55° „ 32°	46 7	45 4	1 3	6	„ „
228	2¼	3–2	7 x 6	9 „ 55° „ 32°	45 1	43 14	1 3	6	„ „
175	2½	3–2	5 x 5	12 „ 55° „ 32°	41 7	40 0	1 7	6	Pack ¼ inch slack
156	2¾	2–2	7 x 6	15 „ 55° „ 32°	43 14	42 10	1 4	4	„ „
156	2¾	2–2	7 x 6	18 „ 55° „ 32°	44 0	42 6	1 10	6	No appreciable slackness
193	2½	3–2	6 x 5	21 „ 55° „ 32°	43 0	41 4	1 12	8	Pack ¼ inch slack
228	2¼	3–2	7 x 6	2 „ 65° „ 32°	44 11	44 0	0 11	3	No appreciable slackness
228	2¼	3–2	7 x 6	4 „ 65° „ 32°	46 11	45 7	1 4	7	„ „
193	2½	3–2	6 x 5	6 „ 65° „ 32°	45 4	43 15	1 5	6	„ „
175	2½	3–2	5 x 5	8 „ 65° „ 32°	43 1	41 12	1 5	5	Pack ¼ inch slack
175	2½	3–2	5 x 5	10 „ 65° „ 32°	42 4	41 1	1 3	5	„ „
228	2¼	3–2	7 x 6	12 „ 65° „ 32°	44 12	43 5	1 7	8	„ „
263	2¼	3–2	8 x 7	14 „ 65° „ 32°	46 11	45 5	1 6	8	No appreciable slackness

[*Continued on page 506.*

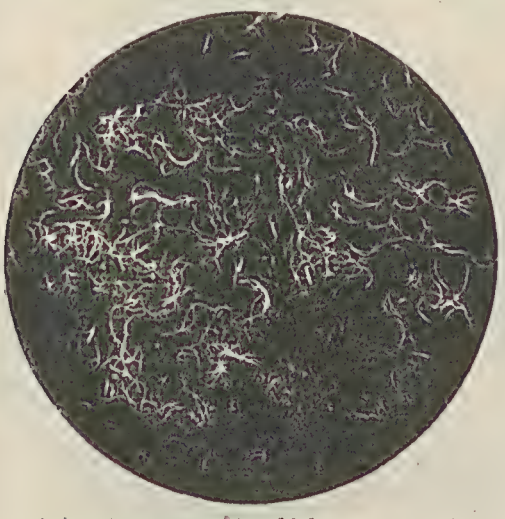
Worms in Cattle

By H. M. Elder, B.V.Sc., Veterinary Officer

WORMS are much more detrimental to the health of cattle than stock-owners generally realize. Although mortality from infestation with worms is relatively uncommon, the economic wastage due to the ravages of worms, especially in young cattle, is extremely serious. Interference with nutrition, with consequent lack of growth and development of young cattle, and digestive disturbances with loss of condition in adult cattle, are frequently the result of parasitism of the alimentary tract. In a number of instances, suitable treatment and the adoption of rational hygienic measures may prevent to a large extent the ravages of worms in cattle.

Stomach and Intestinal Worms.

One of the commonest types of worms affecting cattle is the group known as Trichostrongyles or Short Hair Worms, which includes numerous varieties of small hair-like worms which are very difficult to see without the aid of a magnifying glass. They are found in both the fourth stomach and the intestinal tract, and when present in large numbers give rise to a condition known as Trichostrongylosis.



The short hair worm which causes trichostrongylosis. Natural size.
[After *Ross and Gordon.*

The twisted wire worm or round stomach worm. Natural size.
[After *Ross and Gordon.*

Another type is the twisted wire worm or round stomach worm (*Haemonchus contortus*). This is the largest of the stomach worms affecting cattle, and is found in the fourth stomach, although, in cases of heavy infestation, it may be found in the first portion of the small intestine also. It is a thin, thread-like worm ½ to 1½ inches long, and the females are characterized by red and white striping of the body, giving it a twisted "barber's pole" appearance. This is due to the curling of the ovarian tubes around the blood-filled intestinal tract. Although not so common here as in the northern States of the Commonwealth, infestation with this worm has caused acute parasitic gastritis among young cattle.

The stomach and small intestinal worms of cattle have similar life histories. Each female deposits thousands of eggs, which pass out in the animal's faeces, or droppings, and under suitable conditions of warmth and moisture the eggs hatch out within a few hours, but in cold weather this may be delayed for days. The small embryos, after feeding for three or four days upon the faeces, undergo certain changes, and then ascend blades of grass and are ingested by grazing cattle. This stage is an extremely resistant one, and under favorable conditions of heat and dryness worm larvae may survive on pastures for months, although long periods of drought and extreme cold markedly shorten

the period of survival. After passing to the stomach or intestines, the larvae bore into the mucous membrane. They grow rapidly, and become mature within three weeks.

Symptoms.

There are certain general symptoms exhibited by all worm-infested cattle, but it is often possible to differentiate between infestation with the twisted wire worm and that with hair worms. In the former case, the chief symptom is anaemia, indicated by paleness of the mucous membrane of the eyes, mouth, and vagina; dropsical swelling between the lower jaws (commonly called "bottle jaw"), loss of condition, and depraved appetite. Diarrhoea is not a regular feature. Both young and old cattle are affected, mainly in the late spring, summer, and autumn. Young cattle, if heavily infested, may succumb while still in good condition. The stomach worm is an avid blood sucker, and the anaemia which is a characteristic symptom of its effects is directly due to the abstraction of blood from the lining of the stomach. Trichostrongylosis, the condition caused by the short hair worms, mainly affects young cattle from weaning up to two years of age. Older cattle are more resistant to these worms, but if grazed on heavily worm-infested pastures at times when the pasture has lost much of its nourishment, trichostrongylosis may develop even in them. In young cattle the most marked symptoms are stunting of growth and scouring. Quite frequently only certain individuals in a herd of young stock show evidence of this disease, and in addition to being under-developed, they present a dejected, unthrifty appearance, while the faeces are greenish black, liquid, and offensive. Symptoms of anaemia may not be apparent for some time, and bottling under the jaw is rarely seen. When scouring develops, condition is lost rapidly, although affected animals may linger in an emaciated condition for weeks before succumbing.

Treatment.

As with sheep, treatment for worms in cattle consists of drenching with a solution of copper sulphate (bluestone) and nicotine sulphate. The copper sulphate should be of good quality, and is best obtained from a chemist. The mixture consists of 2 oz. of copper sulphate, 2 oz. of nicotine sulphate, 1 gallon of water, and must be prepared in an enamel or earthernware vessel. The copper sulphate should be dissolved in about a quart of boiling water, cold water added to make 1 gallon, and then the nicotine sulphate added. This quantity is sufficient to drench sixteen mature cattle, or 32 yearlings. The dose required varies with the age of the animal according to the following table:—

Mature cattle	10 oz.
Yearling cattle	5 oz.
Calf, 9 months old ..	4 oz.
Calf, 6 months old ..	3 oz.
Calf, 4 months old ..	2 oz.

On grossly contaminated pastures, cattle will rapidly become re-infested, and for this reason one treatment is not sufficient. Drenching should be repeated three times at intervals of fourteen days. Starvation prior to drenching is unnecessary. Wormy cattle should also be given a supplementary ration of concentrates to build up the constitution, which is weakened by the ravages of the worms.

Nodular Worm.

Another worm common in cattle in Victoria is the nodular worm (*Oesophagostomum radiatum*). This is a short thread-like worm found in the large intestine. During a certain stage in its development it invades the bowel wall, and causes the formation of small rounded

Showing nodules formed in the intestine as a result of activity of the nodular worm.

nodules. Consequently, the condition of nodular disease has become universally known as "pimply gut" or "knotty gut." The adult worms are white in colour, and vary in length from ½ to ¾ of an inch. This parasite has a wide distribution in Victoria, particularly in areas of high rainfall, and where irrigation is practised.

The life cycle of the nodular worm resembles closely that of the worms previously described, up to the stage when the larvae became encysted on the pasture. When swallowed, the larvae pass with the food to the small intestine, from which they migrate into the bowel wall, causing nodule formations. In these nodules they undergo development and return to the bowel after a variable period of 15 to 150 days, reaching maturity in a few days. Migrating larvae may lodge in other portions of the digestive tract, and in the liver, intestinal lymph glands, and omentum or caul. In these latter cases the larvae die.

The presence of the larvae in the intestinal wall gives rise to inflammatory changes which result in nodule formations. These vary in size from that of a pin's head to that of a pea, and contain varying quantities of whitish or greenish pus. After development the larvae escape and the small rupture of the bowel wall heals. Old nodules are frequently cheesy in consistency or even gritty, due to the deposition of lime salts. Normal digestive processes are greatly interfered with by the presence of nodulation. The common symptoms of nodular disease are wasting and diarrhoea. In very acute cases the animal may walk with a stiff stilted gait, particularly in the hind limbs.

Treatment.

Treatment for this disease is not so satisfactory as for other worms in cattle. The nodules cannot be reached with drugs, and the adult worms are difficult to deal with owing to the site in which they are found, i.e., the large intestine. Drenching as prescribed for short hair worms has been followed by some improvement.

Lungworm.

Still another worm affecting cattle is the lungworm (*Dictyocaulus filaria*) which inhabits the air passages in the lungs. The lungworm has proved troublesome only in young cattle from weaning age to about eighteen months. The adult worms are white in colour and thread-like, and 1 to 4 inches in length. They are found lying coiled in tangled masses,

The lungworm. Natural size.
[After *Ross and Gordon.*

mixed with mucus, in the terminations of the air passages, although in heavy infestations they may actually be found in the windpipe.

Lungworm disease is common in low-lying marshy districts of high rainfall, and in areas subject to inundation, and on poorly drained irrigation areas. Usually it appears at a time when the nutritive value of pasture is at its lowest, i.e., during winter. The eggs of the lungworm are laid in the bronchi and are usually coughed up and swallowed. They hatch out in the bowel, and the embryos pass out with the faeces. After feeding for about eight days they become encysted on blades of grass, and are then ingested by grazing animals. The larvae bore through the wall of the intestine into blood vessels and are carried to the lungs in the blood. Five to seven weeks later adult worms are found in the bronchi.

In an affected herd one first notices an odd animal coughing, especially following exertion. In the early stages the cough is short and dry but later often is accompanied by a discharge of mucus from the nostrils or mouth. This discharge contains ova and embryos, and frequently is swallowed when coughed into the mouth, the eggs being passed later in the faeces. The disease develops as an insidious bronchitis which may develop into pneumonia. As it progresses affected animals may show emaciation, anaemia, dry harsh coat, hide bound, bottling of the jaw, and swelling of the dewlap. Death may result from pneumonia or exhaustion.

Treatment.

Treatment with drenches has not been successful owing to the location of the parasites in the lungs. Inhalations and injections into the trachea (or windpipe) offer better prospect for treatment but are not easily carried out. Lungworms are seldom found as a sole infestation, and are usually associated with stomach and intestinal worms. Drenching for these will greatly relieve the affected animals, and if they are moved from the source of infection and given an abundant supply of good food, they can usually withstand the effects of the lungworm and gradually recover.

Preventive Measures.

Where infestation with stomach, intestinal, or lung worms has proved troublesome, preventive measures should be adopted to protect the cattle, especially young animals. Affected animals should be removed to clean pasture and drenched at least three times at fortnightly intervals. A system of rotational grazing and spelling of paddocks should be adopted. Horses may be grazed on paddocks being spelled. Sheep should not be used as they may become affected with the worms from cattle. Weaner calves should not be grazed on areas which have previously been used for older cattle. Provide adequate nutrition and supply a good mineral lick, such as the following:—

Salt	71 lb.
Dicalcic phosphate ..	15 lb.
Sulphur	5 lb.
Magnesium sulphate ..	3 lb.
Sulphate of iron	1 lb.
Molasses	5 lb.

This guards against the lowering of the resistance of the animals through mineral deficiency.

Burning off infested pastures should be considered, as this is a valuable aid in preventing infestation developing serious proportions. Care should be taken, however, not to prevent seeding of grasses.

Overstocking should be avoided. Attention should be paid to the adequate drainage of properties, as cattle on badly drained paddocks are much more subject to infestation with worms.

Where strict attention is paid to these details as part of the routine management of the farm economic wastage due to ill effects from worm infestation will be reduced to a minimum.

Poultry Tick Fever

TICK fever of poultry is due to the presence in the blood of fowls of minute organisms known as spirochaetes: these organisms are introduced into the blood of the host animals by two varieties of external parasites—The Poultry Tick and the Red Mite. The mortality of the disease may be up to 80 per cent. of a flock, but it is found that birds raised in an infected locality do not suffer so severely as the birds introduced from clean flocks.

In addition to transmitting the disease of tick fever to poultry, both ticks and mites cause serious effects through the continued drain on the birds by the ingestion of blood, while irritation from their presence may in itself be serious.

The poultry tick is a pale yellow oval tick, very flat when unengorged, but becoming thickened and leaden-coloured when newly fed. Adult females are up to half an inch in length. They live in crevices in timber and under the bark of trees. Eggs are laid and larvae are hatched there. These larvae attach themselves to the host for a period of five to ten days, when they drop off and seek shelter in crevices. After a series of moults the larvae reach the adult stage and the adults, unlike the larvae, feed on the birds for short periods only. It is important to note that adult ticks may survive for many months without food. Where infestation of old unsanitary fowlhouses with tick is heavy, it is often cheaper to burn them and build new ones on a fresh site.

If carried out with thoroughness the following measures will control ticks:—

All litter should be removed and burned.

All crevices should be gone over with a painter's blow lamp.

Nesting boxes should be removed and replaced by tins.

Perches should be suspended by wire from the roof and for preference be constructed of iron.

Walls should be sprayed with kerosene emulsion and subsequently all woodwork should be sprayed with fuel oil.

All-Australian Porker and Baconer Carcass Competitions

The second series of the All-Australian Porker and Baconer Carcass Competitions which were judged in London during June last resulted as follows:—

PORKERS.

1st, Wickham and Candy, "Wara," O'Halloran Hill, South Australia.

2nd, M. G. Bayliss, Maleny, Queensland.

3rd, Kingston Pig Farm Co., Kingston, Queensland.

BACONERS.

1st, A. Vigano, South Morang, Victoria.

2nd, Inspector-General of Hospitals, Bedford Park, South Australia.

3rd, O. F. Haach, Beenleigh, Queensland.

The full schedule of points awarded to the Victorian entries in each section is shown in the following tables:—

AUSTRALIAN MEAT BOARD—PORKER COMPETITION.

Entrant. Breeding of Entry.	Weight.	"A" Marketing Points.				"B" Breeders' Points.																Total "A" and "B" 115.	Marks.
						By Inspection.			By Measurement.														
									Eye Muscle 28.			Fat Thickness 20.			Body Length 20.			Leg Length 5.					
		Skin.	Colour.	Dressing.	Total.	Hams.	Shoulders.	Streaks.	Ideal.	Actual.	Points.	Ideal.	Actual.	Points.	Ideal.	Actual.	Points.	Ideal.	Actual.	Points.	Total 100.		%
J. T. Tweddle, Pine Lodge, Harkway, No. 1 Middle White x Middle White	82	5	4	5	14	7	4	9	(48)	43	23	(11)	14	16	(685)	640	11	(459)	436	5	75	89	77·29
	82	5	4	5	14	6	5	8	(48)	39	19	(11)	16	12	(685)	641	11	(459)	450	5	66	80	69·56
	82	5	4	5	14	7	4	9	(48)	41	21	(11)	15	14	(685)	640	11	(459)	435	5	71	85	73·90
																							73·62
William E. Logie, Campbellfield No. 1 Large White x Large White Middle York Cross	83	5	5	5	15	5	6	9	(48)	31	9	(11)	18	7	(685)	650	13	(459)	487	2	51	66	57·39
	81	5	5	5	15	6	6	9	(48)	31	9	(11)	17	10	(685)	641	11	(459)	500	1	52	67	58·26
	82	5	5	5	15	6	6	9	(48)	35	15	(11)	22	..	(685)	640	11	(459)	480	2	49	64	55·65
																							57·10
James Logie, Campbellfield, No. 2 Large White x Large White Middle York Cross	85	5	5	5	15	6	6	9	(49)	36	15	(11)	15	14	(695)	650	11	(469)	495	2	63	78	67·82
	83	5	5	5	15	6	7	8	(48)	36	16	(11)	12	19	(685)	658	15	(459)	550	1	72	87	75·65
	86	5	5	5	15	5	6	9	(49)	37	16	(11)	19	4	(695)	676	16	(469)	513	1	57	72	62·61
																							68·70
A. Vigano, South Morang, No. 3 Large White x Large White	87	4	5	5	14	7	6	9	(49)	37	16	(11)	13	18	(695)	650	11	(469)	482	3	70	84	73·04
	89	5	5	5	15	5	6	9	(49)	40	19	(11)	19	4	(695)	655	12	(469)	510	1	56	71	61·74
	90	4	5	5	14	6	6	9	(50)	40	18	(12)	19	7	(705)	656	10	(479)	507	2	58	72	62·60
																							65·79
Mario Vigano, 198 Exhibition-street, Melbourne, South Morang, No. 4 Large White x Large White Berkshire Cross	84	5	4	5	14	6	6	7	(48)	33	13	(11)	17	10	(685)	655	14	(459)	503	1	57	71	61·74
	86	4	5	5	14	6	5	8	(49)	37	16	(11)	17	10	(695)	654	12	(469)	492	2	59	73	63·48
	87	4	5	5	14	5	6	7	(49)	29	3	(11)	20	1	(695)	692	19	(469)	492	2	43	57	49·56
																							58·26

AUSTRALIAN MEAT BOARD—BACONER COMPETITION.

Entrant. Breeding of Entry.	"A" Marketing Points.			"B" Breeders' Points.																"C" 15. Suitability of Carcass Weight.	Total "A," "B," "C" 125.	Marks.
				By Inspection.			By Measurement.															
							Eye Muscle 28.			Fat Thickness 20.			Body Length 20.			Leg Length 5.						
	Weight.	Skin.	Dressing.	Total.	Hams.	Shoulders.	Streaks.	Ideal.	Actual.	Points.	Ideal.	Actual.	Points.	Ideal.	Actual.	Points.	Ideal.	Actual.	Points.	Total.			
																						%
I. E. and F. Hawkin, No. 1	150	4	5	9	3	5	9	(54)	47	21	(21)	26	14	(825)	765	8	(569)	594	2	62	15	86	68·80
Large White x Large White	142	3	5	8	3	5	7	(54)	46	20	(20)	22	18	(805)	780	15	(559)	573	3	71	15	94	75·20
	155	3	5	8	3	6	7	(54)	47	21	(21)	23	18	(835)	802	13	(574)	595	2	70	14	92	73·60
																							72·50
A. Vigano, South Morang, No. 2	155	5	5	10	7	5	10	(54)	48	22	(21)	21	20	(835)	800	13	(574)	560	5	82	14	106	84·80
Large White x Large White	152	5	5	10	7	7	9	(54)	48	22	(21)	19	19	(825)	770	9	(569)	597	2	75	15	100	80·00
	153	5	5	10	7	6	8	(54)	50	24	(21)	21	20	(825)	763	8	(569)	603	1	74	15	99	79·20
																							81·33
H. Calvert, Nankivell, Pakenham South, No. 1	154	5	5	10	6	6	9	(54)	43	17	(21)	28	10	(825)	740	3	(569)	590	2	53	15	78	62·40
Large White x Large White	147	5	5	10	5	5	9	(54)	44	18	(20)	23	17	(815)	730	3	(564)	580	3	60	15	85	68·00
	150	5	5	10	5	5	9	(54)	45	19	(21)	23	18	(825)	752	5	(569)	580	3	64	15	89	71·20
																							67·20
W. E. Logie, Campbellfield, No. 3	146	5	5	10	6	5	6	(54)	43	17	(20)	27	10	(815)	765	10	(564)	560	5	59	15	84	67·20
Large White x Large White Middle York Cross	148	5	5	10	6	6	7	(54)	45	19	(20)	24	16	(815)	730	3	(564)	595	1	58	15	83	66·40
	146	3	5	8	8	5	7	(54)	41	15	(20)	24	16	(815)	758	9	(564)	547	5	65	15	88	70·40
																							68·00

Wounds and Injuries to Animals

THE great principle in the successful treatment of wounds and injuries to animals may be summed up in the word "cleanliness". Cleanliness of the wound itself, of the dressings and of the dresser are of the greatest importance, and although wounds will often heal in spite of dirt and bad treatment, they do so much quicker, better, and more certainly when these points are strictly observed. On the other hand, the application of dirty dressings by dirty hands may be the means of spreading disease by infection of the wound, and consequently greatly aggravating the condition.

Stoppage of bleeding, if serious, is the first thing to be attended to. In the majority of wounds in animals bleeding is not serious. The application of pressure by means of light bandaging above and below the wound, or by placing a pad on the wound and bandaging over it is usually sufficient. In more serious cases the application of a tourniquet may be necessary. After stopping bleeding all external blood clots should be washed off with cold water and an antiseptic dressing applied.

An antiseptic is an agent which either kills germs or prevents them growing on wounds; many are known, and although some may be preferred to others for special purposes, it is not, as a rule, of so much importance which particular one is used, as that it should be thoroughly and intelligently used. Probably the most satisfactory antiseptic for general purposes is tincture of iodine.

When a wound appears healthy and with no discharge, water should be used as little as possible and treatment restricted to the use of dry dressings. where washing is necessary the wound and surrounding parts should be carefully dried afterwards and the dressings then applied. Frequent attention to the wound is probably better than the use of coverings to prevent infection by dirt, flies, &c. The use of carbolic preparation sprayed round the edges of wounds will often act as a fly-deterrent.

Plenty of shade is a boon to stock during both winter and summer.

Trees for Shade and Shelter

By Alex Mess, Senior Dairy Supervisor

THE only trees many farmers ever plant are a few for shelter around their homesteads. Their neglect can be ascribed mainly to thoughtlessness, though perhaps with some it is a desire to conserve space—surely a foolish economy.

Is it not pitiable to see cattle in cold weather, with backs hunched, restlessly feeding and then seeking any little protection they can from the piercing wind? Again, on hot days it is equally distressing to watch unfortunate animals looking about listlessly for some shady corner. What a contrast it is when in winter cows can graze quietly in the shelter of hedges or a plantation of trees that in summer will give ample shade in which the herd can lie down during the heat of the day and quietly chew the cud.

Cows that are not given protection from cold winds must draw on their strength reserves to maintain bodily warmth; this will soon mean a drop in the milk yield and a falling off in the animal's condition as well. If in summer they cannot find shelter from the hot sun they become discontented, and a discontented herd is not likely to be a profitable one.

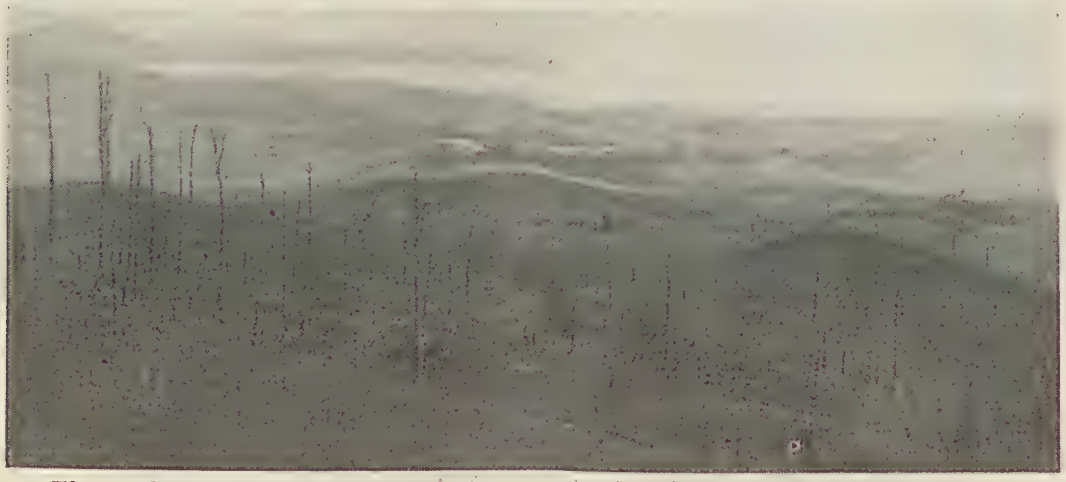
These surely are sufficient reasons for the planting and preservation of shelter trees on the farm; but there are several others. One is the provision of firewood. To many the lack of fuel may seem such a remote possibility as to be an

A shade and shelter belt of cyprus in the Caldermeade district.

insufficient inducement to save a few trees when country is being cleared. It is not until the buying of fuel becomes necessary that one realizes how easily it could have been grown on uncultivable areas. To the early settlers of Gippsland the suggestion of saving trees for fuel would have seemed fantastic, yet to-day there are Gippsland farms to which briquettes are "imported."

The humus formed by the decaying leaves of trees is a valuable addition to the soil and helps to make certain constituents more readily available as plant food. Thus we may say that trees are soil-makers, and further, they are soil-preservers, for those growing near streams protect the banks, and their roots form a sort of filter that prevents over-rapid and erosive drainage.

It may be that because of the outlay necessary for the erection of guards and fences some farmers are deterred from planting trees and hedges. But, quite apart from the attractiveness they give to a home and its surroundings, any expenditure on tree plantations would be returned many times over.



Thousands of acres in South Gippsland are like this. Farmers have to buy firewood and fence posts.

Christmas Mails for the United Kingdom and Europe

The time has now arrived to prepare Christmas gifts and greetings for despatch to relatives and friends in the United Kingdom and Europe.

To ensure delivery of parcels before Christmas, they must be posted in time to reach the General Post Office, Melbourne, before noon on Monday, 7th November, when the mail closes for despatch per the R.M.S. *Orcades*.

The small packet and letter mails for delivery before Christmas in the United Kingdom and Europe will be despatched per the R.M.S. *Strathallen*. Packet mails will close at the General Post Office, Melbourne, at 3.15 p.m. on the 18th November, and letter mails at 4.15 p.m. on that date.

Although the *Strathallen* packet and letter mails will reach London on the 17th December, 1938, the public is exhorted to post, so far as is practicable, Christmas mail for the United Kingdom and Europe in time for despatch per the R.M.S. *Orcades*, as there will be a large accumulation of mail matter for delivery in the United Kingdom and Europe during Christmas week. The packet mail for despatch by the *Orcades* will close in Melbourne at 3.15 p.m. on the 11th November, and the letter mail at 4.15 p.m. on that date.

Senders of parcels and small packets are required to fill in and affix thereto a declaration form indicating the nature and value of the contents, and both parcels and small packets must be posted by being handed in over the counter of a Post Office.

Grain Crops

World Position and Outlook

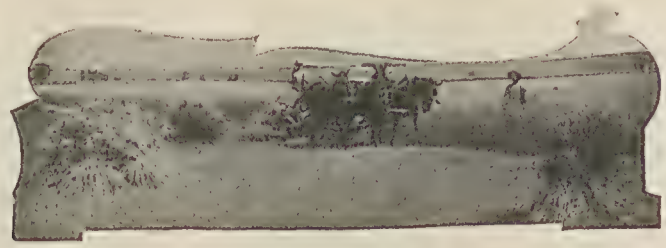
THE Imperial Economic Committee's annual review of "Grain Crops," just published by H.M. Stationery Office, London (price 2s. 6d. net, 2s. 8d. post free), shows how rapidly conditions in the world market for wheat have changed in recent years.

The world's visible stocks of wheat totalled over 32 million tons at the end of the 1933–34 season. From this peak they had been so much diminished by August, 1937, that the total of 14¼ million tons was the smallest figure for over ten years. Prices rose sharply in 1936–37 with the fall in supplies, and farmers all over the world sowed an appreciably larger area with wheat for the 1937–38 crop than in the previous season. Though there was not a proportional increase in the world production of wheat (excluding Russia and China), nevertheless the harvest was larger than in any of the three preceding seasons. Consequently, stocks this August are expected to show an increase of some 2 million tons over last year, much of this increase occurring in the United States, where the wheat crop in 1937 was bigger than at any harvest since 1931. Stocks in Canada and Argentina are unlikely to differ much from the totals recorded in August, 1937, for in both countries the last crop was small, as a result of drought and frost damage respectively.

The Imperial Economic Committee's review describes the recent changes in the wheat trade of the principal countries. The United States, having bountiful supplies in the current 1937–38 season, has resumed its old position as a wheat exporter, whereas last season it was importing heavily. The Soviet Union has increased its exports, whilst Australia also has larger supplies available. On the other hand, both Canada and Argentina have only a small exportable surplus. Last season Italy and Germany were large importers. This season Germany has again been importing on a considerable scale. Italy's immediate import requirements were less because of the large harvest reaped in 1937. In some parts of Europe, notably in Italy, the harvest from the 1938 crop is likely to be comparatively small, due to adverse weather this spring. Larger imports may therefore be necessary. In the Far East hostilities have curtailed imports.

As to the future position, the review draws attention to the fact that in few parts of the world has there been any indication that the area devoted to wheat for the 1938–39 crop will be substantially reduced as compared with the last sowings. Since last autumn the price of wheat has shown a downward trend, and recently the decline has been rapid, due very largely to the prospect of a bumper harvest in the United States this year. It is too early yet to judge what the final outturn will be, but it seems that the world crop, providing the harvests are normal, may be substantially larger than the demand, even if the European demand is stimulated by government purchases to build up reserves of wheat against possible emergency needs.

The review also covers barley, oats, maize, rye, and rice. It forms a convenient source of information on world cereal production and trade in the years 1930–37 and particularly on the part played by British Empire countries. Special sections deal with the net trading position of the Empire, imports into the United Kingdom, the trend of prices, and on customs duties and import restriction in the chief European importing countries.



Poultry Feeding Tests

Results at Werribee

W. O. Pederick and A. G. Clark

THE poultry flock at Werribee is accommodated in up-to-date houses, comprising 24 breeding pens, 130 pens for single testing and experimental work, a brooder house (60 feet x 15 feet) heated with hot-water pipes, a chicken-house (60 feet x 15 feet), a laying shed to accommodate 450 hens, shed to accommodate 500 pullets for feed experiments, feed-room and grain silos, store-room, workshop, egg-room, office, and incubator room with incubator capacity for 1,800 eggs.

Approximately 1,500 White Leghorns and Australorps are being used for breeding experiments, feeding tests, and for egg production. The White Leghorn and Australorp stud flocks each consist of 150 birds, all of which have been bred from tested stock. Careful records of the performances of these birds have been kept for many years.

Extending over a period of twelve months from the 1st April, 1937, to the 31st March, 1938, several poultry feeding tests were conducted at the State Research Farm Werribee. For the purpose 500 pullets were used, consisting of six pens of Australorps with 50 birds in each pen, and four pens of White Leghorns with 50 birds in each. All birds were kept confined, i.e., there was no outside run, although succulent green feed was supplied daily and shell-grit was always available.

The accompanying tables give particulars of the food consumed, the eggs laid, and their value, the profit over food cost, the weight of the birds and the mortality in each pen. The cost of food was arrived at by taking the wholesale prices published in the press weekly, and all eggs laid were valued at the top wholesale prices for eggs averaging 24 oz. per dozen. No deductions have been made for marketing charges, &c. Those birds that died were replaced.

In last year's feeding tests, the results of which were published in the *Journal of Agriculture*, October, 1937, birds in two pens were fed on soaked grain, with free choice meat meal, &c. Although the egg production was satisfactory, the cost of food was very high owing to the large amount of protein concentrates (meat meal, &c.) consumed. In this year's tests the soaked grain system of feeding was given a further trial with both Australorps and White Leghorns. The grain was soaked in water for 24 hours—allowed to drain for a further twelve hours—and fed in troughs twice a day.

In Pens Nos. 1 and 8, meat meal, linseed, and bone meal were mixed with the soaked wheat

Average Weight of Birds.

Showing the average weight of the birds in each pen at different periods, also the number of deaths recorded in each pen during the test.

	Pen No.									
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
April, 1937	5·66	5·52	5·62	5·66	5·7	5·8	4·18	4·5	4·4	4·2
September, 1937	5·45	5·72	5·92	6·5	6·9	6·13	4·24	4·2	4·14	4·08
March, 1938	5·66	5·88	5·87	5·08	6·89	6·24	4·32	4·42	4·38	4·38
Number of deaths recorded in each pen ..	3	3	2	2	2	2	2	3	1	3

just prior to feeding, and in Pens Nos. 2 and 3 (Australorps) and 9 and 10 (White Leghorns) the meat meal was available at all times.

It will be noticed that in all pens receiving soaked grain, i.e., Nos. 1, 2, 3, 8, 9, and 10, the total weight of food consumed was much less than that in the other pens, but the amount of meat meal was much higher. The egg production, with the exception of Pen No. 2 and the weight of the birds at the conclusion of the test, were not so satisfactory in the soaked grain pens as they were in the pens which received the ordinary systems of feeding, i.e., wet and dry mash and dry grain.

Test No. 18.

WERRIBEE FEED TESTS—1ST APRIL, 1937, TO 31ST MARCH, 1938.

Pen No.	50 Birds per Pen.	Bran.	Pollard.	Meat Meal.	Linseed Meal.	Bone Meal.	Wheat.	Oats.	Maize.	Barley.	Total Food.	Cost of Food.	Eggs Laid.	Value of Eggs.	Profit over Cost of Food.
		lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	£ s. d.		£ s. d.	£ s. d.
1	Australorps — Soaked wheat, &c. ..	..	..	365	182	45	2,920	..	..	..	3,512	15 6 2	7,568	44 12 0	29 5 10
	Average ..	..	..	..	..	..	..	..	..	..	**70·2**	**0 6 1**	**151·4**	**0 17 10**	**0 11 9**
2	Australorps — Soaked wheat, free choice meat meal	..	..	457	..	..	3,285	..	..	..	3,742	16 2 9	9,175	54 2 2	37 19 5
	Average ..	..	..	..	..	..	..	..	..	..	**74·8**	**0 6 5**	**183·2**	**1 1 8**	**0 15 2**
3	Australorps — Soaked mixed grain, free choice meat meal	..	..	235	..	..	1,949	364	486	486	3,520	15 8 5	8,517	50 7 4	34 18 11
	Average ..	..	..	..	..	..	..	..	..	..	**70·4**	**0 6 2**	**170·3**	**1 0 2**	**0 14 0**
4	Australorps—Wet mash, free choice grain ..	383	766	128	..	..	1,780	775	605	385	4,822	19 15 1	9,151	54 10 6	34 15 5
	Average ..	..	..	..	..	..	..	..	..	..	**96·4**	**0 7 11**	**183·0**	**1 1 10**	**0 13 11**
5	Australorps—Free choice meat meal and grain	..	..	253	..	..	1,825	910	676	506	4,170	17 17 9	8,391	49 13 0	31 15 3
	Average ..	..	..	..	..	..	..	..	..	..	**83·4**	**0 7 2**	**167·8**	**0 19 10**	**0 12 8**
6	Australorps—Dry mash, free choice grain ..	140	280	47	..	..	1,826	877	793	488	4,451	18 17 1	8,989	53 18 3	35 1 2
	Average ..	..	..	..	..	..	..	..	..	..	**89·0**	**0 7 7**	**179·8**	**1 1 7**	**0 14 0**
7	White Leghorns—Dry mash, free choice grain	235	470	78	..	..	1,707	902	417	372	4,181	17 2 4	9,089	53 17 3	36 14 11
	Average ..	..	..	..	..	..	..	..	..	..	**83·6**	**0 6 10**	**181·8**	**1 1 6**	**0 14 8**
8	White Leghorns—Soaked wheat, &c.	..	..	365	182	45	2,920	..	..	..	3,512	15 6 2	8,050	47 13 11	32 7 9
	Average ..	..	..	..	..	..	..	..	..	..	**70·2**	**0 6 1**	**161·0**	**0 19 1**	**0 13 0**
9	White Leghorns—Soaked wheat, free choice meat meal	..	..	434	..	..	3,285	..	..	..	3,719	16 0 3	8,527	50 8 3	34 8 0
	Average ..	..	..	..	..	..	..	..	..	..	**74·4**	**0 6 5**	**170·5**	**1 0 2**	**0 13 9**
10	White Leghorns—Soaked mixed grain, free choice meat meal	..	..	346	..	..	1,949	364	486	486	3,631	16 0 4	8,304	49 6 3	33 5 11
	Average ..	..	..	..	..	..	..	..	..	..	**72·6**	**0 6 5**	**166·1**	**0 19 9**	**0 13 4**
	Total—500 birds ..	..	..	..	..	..	..	..	..	..	39,260	167 16 4	85,761	508 8 11	340 12 7
	Average ..	..	..	..	..	..	..	..	..	..	**78·5**	**0 6 9**	**171·5**	**1 0 4**	**0 13 7**

Note.—Average price of eggs, 1s. 5d. per doz. Food cost per dozen eggs 5·6 pence. Food consumed per egg laid, 7·3 oz. Food consumed per bird per day, 3·4 oz. Cost of food per bird per week, 1½d.

It is interesting to compare the results in Pens Nos. 2 and 3 (Australorps) and Pens Nos. 9 and 10 (White Leghorns). In each case the birds receiving soaked wheat and meat meal laid more eggs and showed a higher profit over food cost than those fed on soaked mixed grain and meat meal, and although the birds had free access to the meat meal in all these pens, for some reason, much more meat meal was taken in Pens Nos. 2 and 9 (soaked wheat) than in Pens Nos. 3 and 10 (soaked mixed grain).

The results of these tests again show that birds will lay reasonably well on many different systems of feeding and on rations that vary considerably in their protein content. In addition, with feed prices at the present level the usual soaked wheat system of feeding, as used in Pens Nos. 1 and 8, has not been found to be economical when compared with the other systems.

Further feeding tests are now in progress, the object of which is to test different percentages of meat meal in conjunction with dry mash. Five pens, each of Australorps and White Leghorns, are being tested and the percentage of meat meal in the dry mash varies from nil to 15 per cent.

Photo-Sensitization in Sheep and Lambs

By H. M. Elder B. V. Sc., Veterinary Officer.

SHEEP and lambs are frequently affected on the exposed parts of the head with a condition resembling acute sunburn. The areas not protected by wool, that is, the face and ears, become swollen, and later, the affected skin undergoes necrosis, giving a scabby appearance, with subsequent sloughing of the affected skin. In more acute cases jaundice develops and death may ensue. Post-mortem examination reveals typical symptoms of jaundice —the skin and the fat throughout the body are yellow, the liver is yellow and very friable, and the urine is very dark in colour.

The condition is due to photo-sensitization, or acute sensitivity of the exposed parts of the body to the light of the sun. The pigment responsible for the photo-sensitivity is phyllo-erythrin, a derivative from chlorophyll, the green colouring matter of plants. The photo-sensitizing pigment is not present in the plant but arises as a result of microbial activity during the normal course of digestion, the bacteria present in the rumen or paunch acting on the chlorophyll. When there is an excessive amount of chlorophyll, the liver cannot deal with the excess of phyllo-erythrin produced and jaundice ensues. Photo-sensitization may be caused by any chlorophyll producing plant, but the plants known to cause the condition in Victoria are trefoil, St. John's wort, stinkwort, and Panicum or summer-grass.

When the condition develops where sheep have been grazing on Panicum, jaundice is more liable to ensue. This jaundice must not be confused with toxaemia jaundice or "yellow disease" which is a totally different disease. Photo-sensitization is also quite distinct from the disease commonly known as "scabby mouth." The disease recently reported from New Zealand, as facial eczema in sheep, was found to be due to photo-sensitization. Just as black members of the human race are not susceptible to sunburn, so black sheep and black-faced breeds are not, as a rule, affected by photo-sensitization, the black pigment of the skin protecting it from the effect of the sun's rays.

Treatment consists mainly in moving sheep from pasture containing trefoil or other of the plants mentioned above, and placing them in a paddock where there is ample shade. Affected parts should be dressed with an antiseptic ointment mixed with lamp-black. A suitable dressing would be carbolized vaseline mixed with lamp-black, the lamp-black having a similar effect to the black pigment of the skin in protecting the skin from the rays of the sun.

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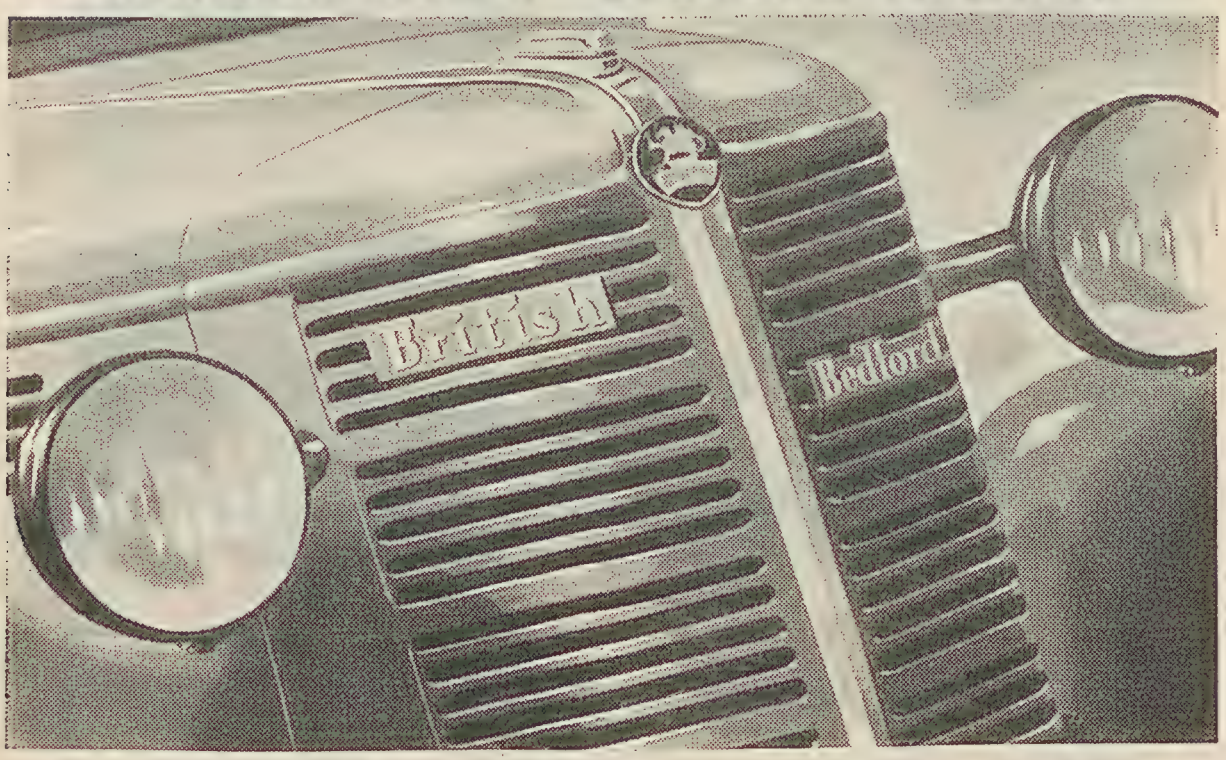

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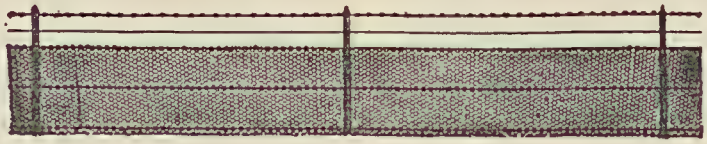

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By J. L. Provan, B.Agr.Sc., Senior Horticultural Instructor.

Orchard Notes.

OCTOBER might be called the month of blossom in the orchard. The late-flowering varieties of cherries, Bigarreau Napoleon, Florence, and St. Margaret will complete their blooming period during the first week. Of these varieties, Bigarreau Napoleon frequently sets fruit without cross-pollination, but generally the provision of pollen of other varieties blooming at the same time, increases the setting of cherries. For the popular late variety—St. Margaret—Reine Hortense, Florence, and Bigarreau Napoleon will be found to be good pollinators.

Josephine and Winter Nelis, W.B.C., and Buerré Bosc pears will be still blooming during the early part of the month. Josephine and Winter Nelis are popular cross-pollinators, and these two varieties, together with Packham's Triumph, which blossoms a little earlier, make a valuable trio in the orchard. W.B.C. and Buerré Bosc pears are also good inter-pollinators, and growers who have provided cross-pollination for W.B.C. claim that, with these, the set of fruit is heavier, and a smaller percentage of misshapen pears is obtained.

The majority of apple varieties bloom during October. Varieties which bloom with the Jonathan include the following:—Stewart, Democrat, Rokewood, Cleopatra, Yates, Granny Smith, and Statesman. In the Mornington Peninsula district two other popular pollinators for the Jonathan are Duke of Clarence (for early blooms) and Sunnyside (Syn. Summer Scarlet Pearmain). Lord Suffield and Yates are useful pollinators for Delicious. The late-flowering varieties London Pippin (Five Crown), Rome Beauty and Hoover are good inter-pollinators. It is not suggested that all these varieties should be planted, because many of them have been displaced by the more valuable commercial varieties; but some of them are such good cross-pollinators that they could be grafted on trees where suitable pollination has not been provided. Such grafts are not allowed to fruit—the fruit is removed soon after setting, so that strong blossom buds can be developed for the following spring. If

provision is made for an early, a mid-season, and a late-blooming variety to be worked on Jonathan trees, more consistent crops will be possible.

Citrus trees will be in full bloom about the second week of October, and during this time and for a period of four to six weeks following, they should not be allowed to suffer from insufficient soil moisture. The lack of adequate soil moisture and the incidence of hot, dry winds at this season of the year, frequently results in a severe drop of the young fruit during late November and early December.

The brown rot fungus may infect young green cherries which have been damaged by looper caterpillars. These injured and infected cherries become partially mummified and remain attached to the tree, thereby providing a subsequent source of infection as the fruit develops. Where looper caterpillars in the past have caused this injury, growers should apply an arsenate of lead spray, 3 lb. of paste to 80 gallons of water, early in October. For the control of brown rot in peaches, a dry-mix lime sulphur spray—25 lb. in 100 gallons—should be applied during this month.

A weak Bordeaux mixture spray—1¼ : 1¼ : 40 may be applied to apricots during the first week of October to assist in the control of "freckle". This spray is applied just as the "caps" fall from the fruit. Growers are warned, however, that it may cause a pink blush on the fruit which later may interfere with its sale to the cannery.

Instructional circulars dealing with the control of black spot of apples, black spot of pears, and codling moth, are available free on application to the Director, Department of Agriculture, Melbourne, C.2.

The Flower Garden

By A. W. Jessep, M.Agr.Sc., B.Sc., Dip. Ed., Principal, School of Horticulture, Burnley

AS the season advances and the days grow warmer, the frequent use of the Dutch hoe between the seedlings will help to circulate the warmer air throughout the soil.

English lawns should now be in full growth; if not, or if too much clover be present, give them a dressing of sulphate of ammonia at the rate of 1½ oz. per square yard. This encourages the grasses and discourages clovers and weeds.

Any further planting of evergreen shrubs should be made as soon as possible to enable them to become established before the advent of the dry hot period.

Since frosty nights are no longer probable, frost-tender plants, such as aster, zinnia, marigold, and salvia bonfire, may now be planted out.

An attractive bowl of Asters.

Flowering fruit trees should be cut back as soon as they finish blooming. The plums and peaches may be cut fairly hard; this will encourage long new branches on which next year's flowers will develop; but the apples and cherries flower on old wood and therefore should be cut very sparingly; the cutting of some of the flowers for indoor decoration is usually sufficient pruning for these. Most deciduous plants must not be pruned until after they finish flowering. Sow seeds of any of the following:—Aster, carnation, celosia,

cosmos, marigold, nasturtium, petunia, phlox, salvia, portulaca, salpiglossis, sunflower, tithonia, zinnia, and dianthus. Plant out chrysanthemums, gladioli, and perennial asters.

Of the many autumn annual flowers, perhaps marigolds are the most useful. They are hardy, have a prolonged flowering period, are obtainable in a wide range of sizes, and the colours blend in well with other flowers.

In the late autumn when most other summer annuals have faded, the yellow, lemon, orange, and brown shades stand out very prominently. When planting out marigolds this month, it must be remembered that the African marigold needs slightly different treatment from the French in order to obtain the best results. The African type requires a rich soil, a rather liberal supply of moisture, and must not be allowed to suffer a check in growth, as it never seems to recover. On the other hand, the French marigold is much hardier and does well in a comparatively poor soil. The dwarf varieties are very hardy, and will grow quite well in relatively dry areas. There are types to suit most situations, and when planted by themselves produce pleasing border effects. The very dwarf Tagetes which have light feathery foliage and small yellow blooms, grow to a height of about 9 inches and make excellent edging plants. The dwarf French marigolds would look well planted behind these, with the taller, striped French ones next in position, and behind these again the large French types, ending with the very tallest African varieties which grow to a height of 6 feet or more, and bear huge orange or lemon-coloured flowers. Some of the varieties grown include the following:—

1. Tagetes.—A very dwarf type rather similar to the French marigold. It makes a useful edging plant, growing to a height of from 6 inches to 1 foot.
2. French marigolds.—Dwarf Double Harmony bears bright golden flowers bordered with maroon, and grows about 12-18 inches in height. The bushy habit makes it a good plant for borders. Grandiflora.—Has large yellow flowers on bushy plants about 24 inches high. Giant Tree French marigold grows to about 4 feet in height, and produces flowers of a bright orange and orange-brown colour. It is particularly useful since it blooms freely till well into the winter if given a little protection.
3. African marigolds.—Guinea Gold is a very decorative type of strong sturdy growth, and grows to about 2 ft. 6 in. in height. It bears an abundance of flowers, of a brilliant orange flushed with gold. Yellow Supreme is a more erect grower, but is not quite so vigorous. It produces numerous loosely ruffled flowers of a pleasing creamy yellow. It is a new strain and should become popular. African Orange and African Yellow are tall-growing types, with very large almost globular double flowers. They make splendid bedding plants.

Two other plants closely allied to marigolds are Calendula and Tithonia. The former are extremely useful, because if sown early they will flower throughout the winter. Orange King and Orange Sunshine are good orange varieties, while Sulphur Queen and Golden Beam are good yellows.

Tithonia speciosa bears single orange-vermillion flowers on long, hollow stalks. As it is tall-growing with a rather brittle stem, it requires a position protected from the prevailing winds. It is very frost-tender, and should not be planted until November. It does best if the seeds are sown in the permanent position.

Vegetable Garden.

October is the most favorable month for the sowing of vegetables, and under suitable soil conditions almost any of the annual types may be sown now. Make sowings of lettuce, cucumber, melon, pumpkin, parsnip, spinach, tomato, cabbage, salad plants, and French beans. Use the Dutch hoe freely between all growing vegetables.

Of the vegetables to be sown this month the French bean is perhaps the most useful. It is sometimes referred to as the Dwarf or Kidney bean, and should find a place in every vegetable garden from October until it is destroyed by frosts. It is a most prolific bearer and easy to grow, and where a good water supply is available, there should be no difficulty in having a supply of beans throughout the summer and autumn months. It will not stand frosts, and should not be sown until all likelihood of a frosty night has passed.

In southern Victoria it is not safe to sow them before early October, but in the northern districts they may be planted relatively earlier. The early plants require about 60 days from

the time of planting in which to produce beans fit for picking, and they will continue to yield for about four to six weeks; therefore, new sowings should be made every month until the end of February.

The area for sowing should be carefully prepared and a light dressing of lime forked in about two weeks before sowing. Add 1 oz. of superphosphate, that is, two tablespoons, for every 8 yards of furrow at time of sowing. Sow in rows 18 inches apart, and in drills or furrows 2 inches deep, and place the seeds from 4 inches to 6 inches apart. Beans require plenty of water, but the ground should be well drained.

Varieties.—There are several very good varieties. The following are probably the most popular:—

Canadian Wonder is very prolific, and is the popular one grown commercially. It produces large pods of tender beans that are almost stringless. It lost a great deal of its popularity some six or eight years ago on account of its susceptibility to bacterial disease, but with careful selection it has regained its former position.

Feltham's Prolific is a hardier variety than the Canadian Wonder, and is very useful for small gardens. It is not so prolific as Canadian Wonder, and the pods are smaller. When the Canadian Wonder lost its popularity it was thought Feltham's Prolific would replace it, but most commercial growers prefer Canadian Wonder. Other good varieties are Pale Dun, Staley's Star, Brown Beauty, and Emperor William.

Wax Pod or Butter Beans are grown in exactly the same manner as the French beans, but are picked just as the pods turn yellow. They are prolific, tender and generally thought more tasty than the green-podded varieties.

The Canadian Wonder bean.

They do not carry well, and therefore find little favour with commercial growers, but for small gardens they are well worth growing. Startler is the most popular variety of Butter Bean in Victoria.

Climbing French Beans.—These are closely related to the dwarf, but take three to four weeks longer to mature. They are more prolific, carry larger and better flavoured beans, and fruit for a longer period than the dwarf varieties. They are a little more troublesome to grow, since they require supports unless grown on a natural one such as a fence or trellis. Epicure is one of the most popular of the climbing varieties; it has a very large, flat, and practically stringless pod of excellent flavour.

The Scarlet Runner is also popular, but the fruit does not always set well, particularly the earlier grown crop. Kentucky Wonder and General McCay are also very useful varieties.

Shrinkage in Jonathan Apples during Cool Storage

(*Continued from page* 490).

more than 40 lb., in the former the apples, although apparently filling the case comfortably when packed, gradually settle down when subjected to the usual jolts, &c., during shipping, and result in the buyer overseas being confronted with slack packs. Our competitors supply Jonathans giving 40 lb. and over to the bushel case, and we must do the same. As a means of ensuring that this is done, it is advised that packers should weigh their packed cases and determine the weight of apples they are packing per case. If it is insufficient, then their method of packing requires altering. Should the packer find difficulty in packing the full weight of apples per case, the Fruit Packing Instruction Branch of the Department of Agriculture will be willing to assist him.

Professional Papers

[This section is devoted to professional papers and articles of a scientific character.]

Eelworm (Heterodera Schachtii Schmidt) Disease of Cereals—Part II

By C. R. Millikan, M.Agr.Sc., Plant Pathologist.

Part I. of this paper appeared in the September issue of this Journal and dealt with the description and life history of H. schachtii, the relation of inoculation experiments to field symptoms and the resistance of cereals to the eelworm.

Rotation in the control of Heterodera schachtii.

IN 1934, an experiment was initiated on an area at Nhill carrying a high population of eelworm cysts in the soil, to determine the value of certain rotational practices in the control of eelworms. During the first two years the area devoted to this experiment was divided into seven large plots, each 96 drill rows wide by 800 links long. Each of these plots, with the exception of No. 2, was halved longitudinally, in 1936, to give two plots 48 drill rows wide by 800 links long (Figs. 32 and 34). These halves of the original large plots were called A and B respectively, and received separate treatments. The remaining large plot, No. 2, was similarly subdivided in 1937. Details of the treatments which each plot received during the experiment are shown in Table III. The varieties of cereals

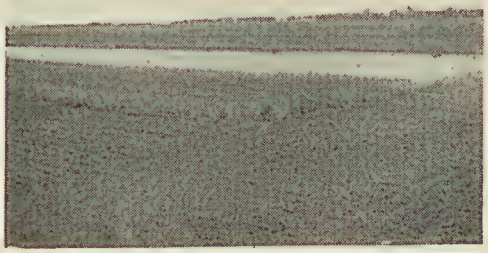

Fig. 32.—Portion of rotation test at Nhill, 1936. The white strip is the Wimmera rye-grass and subterranean clover plot.

Sowing experimental plots at Nhill. The drill was thoroughly cleaned out after sowing each treatment.

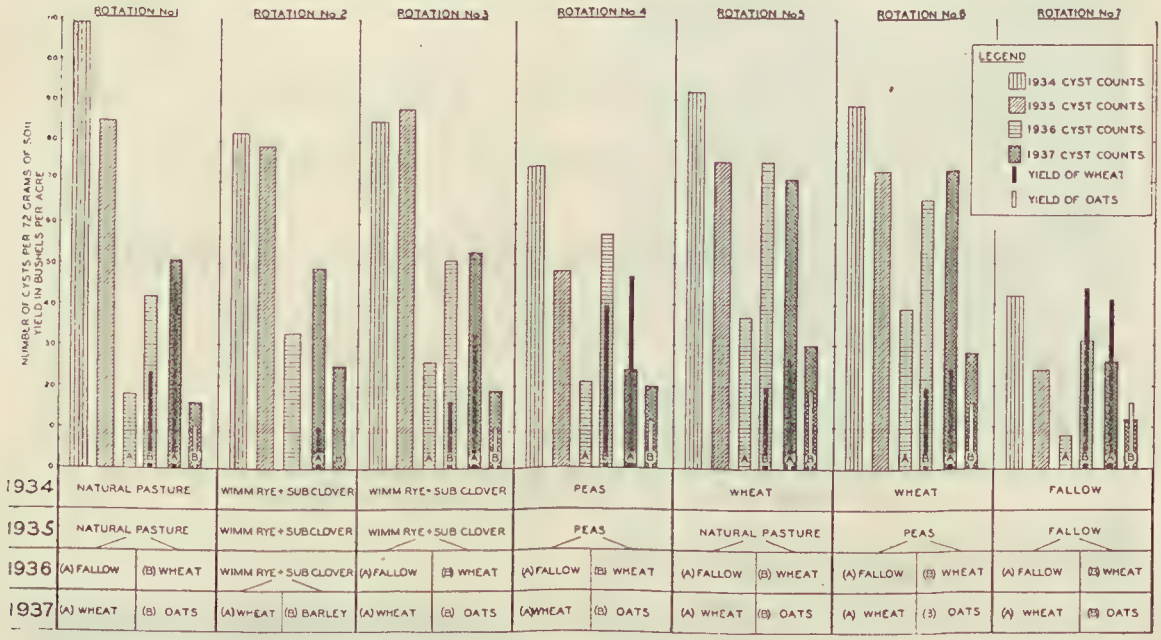
ROTATION No.1
ROTATION No.2
ROTATION No.3
ROTATION No.4
ROTATION No.5
ROTATION No.6
ROTATION No.7
LEGEND
1934 CYST COUNTS
1935 CYST COUNTS
1936 CYST COUNTS
1937 CYST COUNTS
YIELD OF WHEAT
YIELD OF OATS
NUMBER OF CYSTS PER 72 GRAMS OF SOIL
YIELD IN BUSHELS PER ACRE
1934 NATURAL PASTURE | WIMM RYE + SUB CLOVER | WIMM RYE + SUB CLOVER | PEAS | WHEAT | WHEAT | FALLOW
1935 NATURAL PASTURE | WIMM RYE + SUB CLOVER | WIMM RYE + SUB CLOVER | PEAS | NATURAL PASTURE | PEAS | FALLOW
1936 (A) FALLOW | (B) WHEAT | WIMM RYE + SUB CLOVER | (A) FALLOW | (B) WHEAT | (A) FALLOW | (B) WHEAT | (A) FALLOW | (B) WHEAT | (A) FALLOW | (B) WHEAT | (A) FALLOW | (B) WHEAT
1937 (A) WHEAT | (B) OATS | (A) WHEAT | (B) BARLEY | (A) WHEAT | (B) OATS | (A) WHEAT | (B) OATS | (A) WHEAT | (B) OATS | (A) WHEAT | (B) OATS | (A) WHEAT | (B) OATS

Fig. 33.—The results of the rotation test at Nhill, 1934 to 1937. The graph shows the details of the rotational treatments for each year, and the effect of each treatment on the population of eelworms in the soil. Wheat and oat yields are shown also.

sown are as follows:—Wheat—Free Gallipoli; Oats—Mulga; Barley—Chevalier x Pryor; Peas—Dunn.

At the end of each year, after the area had been cultivated, soil samples were obtained from the sites of each plot, and cyst counts were made, by the method described elsewhere in this report, to determine the effect of the previous year's treatment of the plot on its cyst population. In each year a composite sample of soil was obtained from three definite areas in each plot. These areas were 1 chain long by the width of the plot, and the soil sampling throughout the experiment was confined to them. Each composite soil sample from any given area in the original large plots consisted of twenty borings, distributed over the area with a 1-in. diameter soil-sampling tube, to a depth of 4 inches. After subdivision of the large plots the number of borings in the composite samples was reduced to fifteen. Separate cyst counts were made on each of the three soil samples from any particular plot, and the cyst population of that plot was then taken as the average of these three counts. The results of these counts are presented in Table III. A graphical presentation of the results is shown in Fig. 33.

In order to check the reliability of the soil sample method of estimating the effect of rotational treatment on the population of eelworm, representative samples of approximately 170 plants were dug from the wheat plots sown in 1936 and 1937, and the eelworm infestation and occurrence of root rot lesions on the roots was observed. The infestation of the roots of the 1937 sample was expressed quantitatively by the following method. Each plant in the sample was classified for eelworm infestation and allotted points as under:—

Severe infestation, three points; moderate infestation, two points; light infestation, one point; and no infestation, nil.

An index of the severity of eelworm infestation in the sample was then obtained as follows:—

$$\text{Severity index} = \frac{\text{Total points scored}}{(\text{Total number of plants in sample}) \times 3} \times \frac{100}{1}$$

These samples were similarly classified for the occurrence of root rot lesions. The results of these examinations are shown in Table IV. The allocation of points according to the above classification proved to be not entirely satisfactory. Plants showing only a trace of eelworm or root rot damage had to be allowed one point, with the result that the severity index for some samples tended to be higher than was actually the case. The addition of a class for very light

infestation in the above classification would give a severity index that would more closely represent the disease status of the samples.

The observational evidence obtained in 1936 and the quantitative examination of plant samples in 1937 indicated that there was a close relationship between the severity of eelworm infestation of the roots of the wheat crop and the cyst counts on soil samples subsequently obtained from the area after it had been cultivated.

With regard to plots Nos. 2 and 3, which were sown down to Wimmera rye-grass and subterranean clover in 1934, it was found, after the first year, that the clover had practically disappeared, the pasture consisting almost entirely of rye-grass in subsequent years. An excellent crop of peas was grown on plot No. 4 in 1934, but in the following year the peas sown on plots Nos. 4 and 6 suffered severely from wilt (*Fusarium* sp.) and *Ascochyta pisi*.

From an examination of Table III. and Fig. 33, it is seen that the greatest reduction in eelworm soil population resulted from rotation No. 7A. Three years fallow, however, proved insufficient to completely eliminate eelworms from the soil as the subsequent wheat crop on this area was infested. Fuchs (10) has shown that, in the absence of the host plant, eggs of *H. schachtii* can remain viable in the cysts for a period of five years.

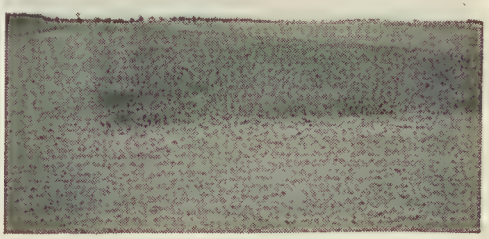

Fig. 34.—Wheat plot No. 7B (after two years' fallow) at Nhill, 1936.

TABLE III.—DETAILS OF ROTATION EXPERIMENT, NHILL, 1934–37, AND RESULTS OF CYST COUNTS SHOWING THE EFFECT OF EACH TREATMENT ON THE POPULATION OF HETERODERA SCHACHTII IN THE SOIL.

Rotation Number.	1934.	1935.	1936.	1937.
1	Natural pasture, 109 ..	Natural pasture, 85 ..	(A) Fallow, 28	(A) Wheat, 51
			(B) Wheat, 52	(B) Oats, 16
2	Wimmera rye-grass and subterranean clover, 82	Wimmera rye-grass and subterranean clover, 79	Wimmera rye-grass and subterranean clover, 33	(A) Wheat, 49
				(B) Barley, 25
3	Wimmera rye-grass and subterranean clover, 85	Wimmera rye-grass and subterranean clover, 88	(A) Fallow, 26	Wheat, 53
			(B) Wheat, 51	Oats, 19
4	Peas, 74	Peas, 48	(A) Fallow, 21	Wheat, 24
			(B) Wheat, 57	Oats, 20
5	Wheat, 92	Natural pasture, 75 ..	(A) Fallow, 37	Wheat, 71
			(B) Wheat, 75	Oats, 30
6	Wheat, 89	Peas, 53	(A) Fallow, 39	Wheat, 73
			(B) Wheat, 76	Oats, 28
7	Fallow, 42	Fallow, 24	(A) Fallow, 8	Wheat, 26
			(B) Wheat, 31	Oats, 12
Standard Error	2·3	5·2	4·3	4·9

Note.—The cyst count figures shown for 1934 represent the number of cysts per 60 ccs. of Nhill soil. The remaining figures represent the number of cysts in 72 grams of soil. Sixty ccs. of Nhill soil weighs approximately 72 grams.

A somewhat similar reduction in soil population to that produced by three years' fallow, resulted from two years' natural pasture, fallow (rotation No. 1A) and two years' peas, fallow (rotation No. 4A). The natural pasture treatment merely consisted in leaving the land out of cultivation and allowing any naturally occurring herbage to grow. The most common weeds growing on this area were *Brassica sinapistrum*, *Lithospermum arvense*, *Polygonum aviculare*, *Papavera dubium*, *Carduus lanceolata*, *Capsella bursa-pastoris*, *Anagallis arvensis*, *Bromus rubens*, *Hordeum murinum*, and *Sonchus asper*. The majority of these plants, and the Dunn peas sown on plot No. 4, may be regarded as non-susceptible, in that no development of worms to the cystic stage was observed. It has been indicated previously, however, that the young roots of these plants are freely penetrated by the larvae of *H. schachtii*, which then die without any further development. This fact would account for the reduction in soil population which results from the growing of these plants on an infected area. During the course of the cyst counts it was noted, after one year's treatment with natural pasture (rotation No. 5) or peas (rotation No. 6) that, although the cyst population figure was not appreciably reduced, there was a marked diminution in the number of viable eggs inside the cysts. This would account for the lower cyst population resulting from the following wheat crops on these plots.

The infestation on the roots of these crops was still, however, very severe. Natural pasture or peas, for one year, followed by wheat, or by fallow, wheat, did not provide a satisfactory control of the eelworms.

A similar reduction in the number of eggs in the cysts was caused by Wimmera rye-grass for two years (rotations Nos. 2 and 3), which was not reflected in any marked diminution in cyst

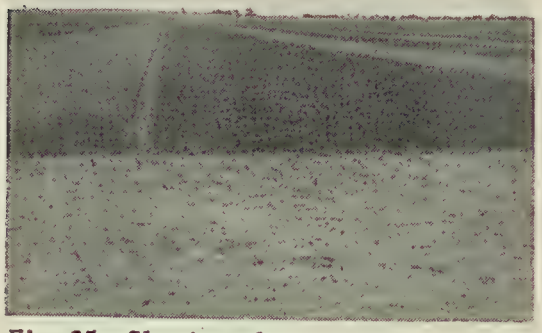

Fig. 35.—Showing alternate wheat and oat plots in the rotation test at Nhill, 1937.

TABLE IV.—RESULTS OF THE EXAMINATION OF WHEAT PLANTS FROM ROTATION EXPERIMENT AT NHILL IN 1937 FOR SEVERITY OF EELWORM INFESTATION AND ROOT ROT LESIONS AND SHOWING THE RELATIONSHIP BETWEEN THE SEVERITY OF EELWORM INFESTATION AND THE CYST COUNTS ON SOIL SAMPLES OBTAINED FROM THE SITE OF THE CROP SUBSEQUENT TO CULTIVATION.

Plot No.	Previous History, 1934–1936.	Eelworm.		Root Rot Lesion Severity Index.	Yield (Bushels per Acre).
		Plant Infestation Severity Index.	Cyst Count per 72 Grams of Soil.		
1A	Natural pasture, two years, fallow	50	51	52	45·1
2A	Wimmera rye-grass and subterranean clover, three years	58	49	83	10·0
3A	Wimmera rye-grass and subterranean clover, two years, fallow	65	53	54	32·8
4A	Peas, two years, fallow ..	26	24	38	46·8
5A	Wheat, natural pasture, fallow	88	71	70	26·7
6A	Wheat, peas, fallow ..	89	73	85	24·2
7A	Fallow, three years ..	40	26	42	41·1

population until after the third year, when either Wimmera rye-grass (No. 2) or wheat (No. 3) was sown on the areas. Although cyst production has been recorded on the roots of Wimmera rye-grass it is not very common. Larvae on the other hand enter the roots of this plant very freely.

Similar results on the effect of non-susceptible plants on the hatching of eggs of the potato strain have been recorded by Triffitt (42–43) and Franklin (9). Triffitt has shown that the root secretions of such plants stimulate the hatching of the eggs in the soil.

In 1937, the "Series A" plots in each rotation were sown with wheat, and the effect of this treatment in increasing the cyst population of the soil is clearly indicated by a comparison of the final cyst count for these plots with the corresponding original cyst population as indicated by 1936 "Series A" figures. It is to be expected

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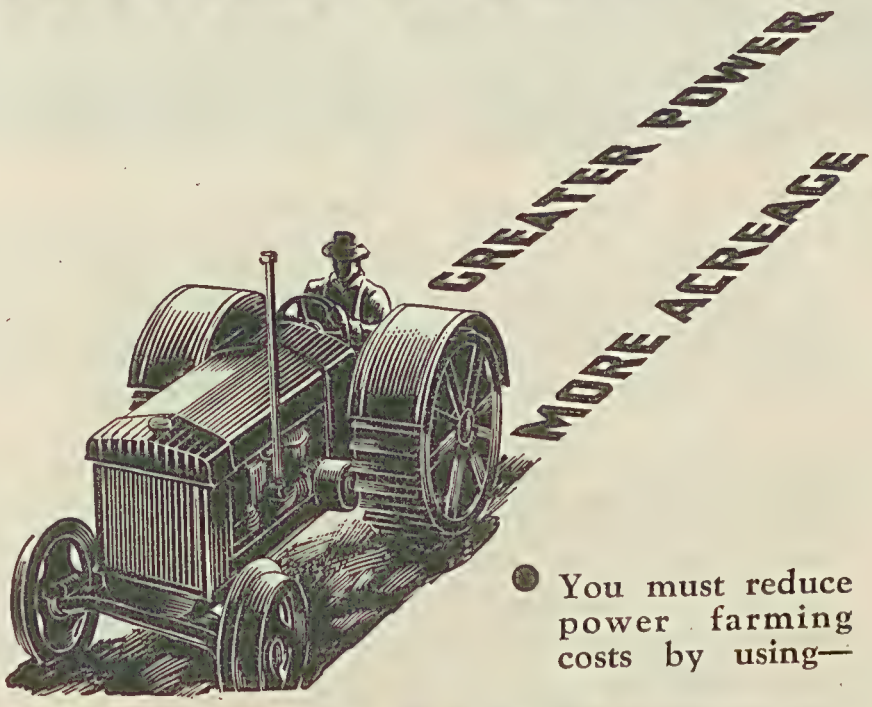

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Fig. 36.—Visitors inspecting experimental plots at Nhill.

therefore that frequent cropping with wheat on eelworm infested areas will maintain a high population of cysts in the soil. Garrett (12) has noted that considerable injury, due to *H. schachtii*, may result where an area has been under cereals for five consecutive years.

The "Series B" plots, with the exception of No. 2B, were sown in 1937 with the resistant Mulga oats, and in contrast with the wheat on "Series A," this treatment resulted in a very marked reduction in the original cyst population of each plot. This result confirms other observations recorded elsewhere in this report on the resistance of this variety to eelworm infestation, and indicates its great value in rotations designed to control the eelworm. It must be noted, however, that the growth of Mulga oats on wheat stubble at Nhill, in common with that of other oat varieties, is normally poor, as the yields of grain shown in Fig. 33 indicate. This poor growth is associated with the free occurrence of root rot fungi, such as *Rhizoctonia solani* and *Curvularia ramosa*.

Plot No. 2B, in 1937, was sown with the barley crossbred Chevalier x Pryor. As the original large plot, No. 2, was not subdivided until 1937, the soil population of the two halves of that plot was the same before the 1937 sowings. It will be seen therefore, that the sowing of the barley resulted in a significantly lower cyst population when compared with that resulting from the wheat which was sown on the other half of this plot. The result confirms other observations to the effect that this barley variety possesses some resistance to *H. schachtii* when compared with Free Gallipoli wheat.

With regard to the yields of wheat obtained from the plots sown with that cereal in 1936 and 1937, indicated in Fig. 33 and Table IV., it was apparent from an examination of the plant samples that these were very closely related with the root development of the plant, as well as with the amount of eelworm infestation and severity of root rot lesions. With the exception of plot No. 4B, in 1936, the root development of wheat sown immediately after natural pasture, Wimmera rye-grass or peas, was relatively poor and very branched, due to eelworm infestation, and the yield was poor. Fallowing the area for one year between these treatments and the following wheat crop, markedly improved the root development and yield of the wheat in 1937, particularly in the case of plot No. 1A (natural pasture two years, fallow, wheat).

Eelworm infestation of the roots of this crop was more severe than in the case of plots Nos. 4A (peas two years, fallow, wheat) and 7A (fallow three years, wheat), yet the root development and yields of grain from all these plots was very similar, indicating the influence of some factor other than eelworm infestation on the growth of the wheat.

Cultures were made of root rot lesions occurring on the roots of the wheat plants in both 1936 and 1937. In 1936 the following fungi were isolated from these lesions:—*Helminthosporium* sp., *Curvularia ramosa*, *Rhizoctonia solani*, *Fusarium culmorum* and *Fusarium* sp. All these fungi were isolated from the roots of wheat grown after two years fallow (plot No. 7B). In the following year, however, the only fungus isolated on the roots of wheat on plot No. 7A (after three years' fallow), was *Fusarium* sp. This would seem to indicate that this fungus was more persistent than the other species which were isolated in 1936. *Fusarium culmorum* occurred on plants from plot No. 4A, while *Rhizoctonia solani* and *Curvularia ramosa* were recorded from plots Nos. 1A and 2A.

Relation between Soil Composition and Eelworm Population.

A survey of the experimental area at Nhill was made in 1935 to determine if a variation in the population of cysts in the soil occurred and if such a variation could be correlated with differences in soil composition. As a preliminary experiment, two soil samples were obtained from the lightly infested areas and two from the heavily infested areas, upon which the experiment (the results are shown in Table I.) was subsquently sown. These results indicated that there was a significant difference in eelworm infestation between these two areas. The results of analyses of these four samples are shown in Table V.

TABLE V.—RESULTS OF ANALYSES OF SOIL SAMPLES FROM TWO AREAS AT NHILL CARRYING DIFFERENT CYST POPULATIONS OF HETERODERA SCHACHTII.

Analysis.	Lightly Infested Area.		Heavily Infested Area.	
	Sample No. 1.	Sample No. 2.	Sample No. 3.	Sample No. 4.
Moisture as received (percentage) ..	6·2	5·7	5·6	6·4
Loss on ignition (percentage) ..	7·4	7·4	8·1	8·4
Sticky point (percentage water on oven dry weight) ..	39·1	39·8	39·8	41·5
Nitrogen (parts per 100,000) ..	78	73	84	95
Phosphoric acid (P_2O_5) (parts per 100,000)	61	48	54	61
Lime CaO (parts per 100,000)	1,840	1,680	2,400	2,640
Reaction (pH value)	8·3	8·3	8·1	8·2

The results in Table V. indicate that nitrogen, lime and loss on ignition (the latter is correlated with lime through carbon dioxide lost on ignition) were highest in the heavily infested areas. There was no significant difference in physical texture as indicated by sticky points, and it was doubtful if there was any significant difference in reaction values. In view of these results further composite samples to a depth of 4 inches were obtained

TABLE VI.—CYST COUNTS AND ANALYSES OF SOIL SAMPLES FROM AN EELWORM INFESTED AREA AT NHILL.

Cyst Counts per 72 grams of Soil.	Moisture as Received.	Loss on Ignition.	Nitrogen p.p. 100,000.	Lime (CaO) p.p. 100,000.	Reaction pH Value.
	%	%			
115 ..	..	..	101	..	..
106 ..	7·9	8·7	90	3,220	8·2
94 ..	7·6	7·3	95	1,700	8·2
93 ..	7·6	7·6	106	1,358	8·1
91 ..	..	..	90	..	..
90 ..	..	..	90	..	..
89 ..	..	..	101	..	..
81 ..	..	..	78	..	..
70 ..	..	..	90	..	..
64 ..	7·4	7·4	78	1,380	7·3
64 ..	..	..	84	..	..
58 ..	..	..	90	..	..
57 ..	..	..	95	..	..
46 ..	7·4	7·9	90	2,460	8·2
43 ..	..	..	90	..	..
26 ..	7·4	7·6	84	1,500	8·5
24 ..	..	..	84	..	..
19 ..	..	..	90	..	..

Fig. 37.—Portion of the barley plots included in the experiment in 1936.

from various parts of the experimental area. Cyst counts were made and the samples were then analysed by the Agricultural Research Chemist (Table VI.). As a result of this work, it was not possible to establish any relationship between cyst population of the samples and loss on ignition, nitrogen, lime or pH value.

Smith (38) found that the normal variations in the physical condition of the soil apparently had no influence on the rate of reproduction of *Heterodera schachtii*. On peat soils he demonstrated a negative correlation between cyst count and pH value of the soil. Carroll (2) on the other hand was unable to find any relation between the pH of the soil and eelworm abundance.

The Depth Distribution of Eelworm in the Soil.

Evidence was obtained as to the depth distribution of the cysts of the eelworm in a heavily infested area at Nhill. Soil samples to a depth of 36 inches were obtained, the soil from each 6-in. depth being kept separate. Cyst counts were made on these soil samples, the average results of which are shown in Table VII.

TABLE VII.—SHOWING THE DEPTH OF DISTRIBUTION OF CYSTS OF HETERODERA SCHACHTII IN THE SOIL AT NHILL.

Depth of Sample.	Average Cyst Count per 72 grams of Soil.
0 in. to 6 in.	78
6 in. to 12 in.	8
12 in. to 18 in.	2
18 in. to 24 in.	0
24 in. to 30 in.	0
30 in. to 36 in.	0

These results indicate that the greatest concentration of eelworm cysts in the soil occurred in the first 6 inches and that very few were present under 12 inches. Similar results have been obtained by Muller and Molz (32) and Goffart (14). They found the heaviest infestation from 10 to 20 cm. below the surface, while none occurred at the 50 to 60 cm. level.

The Relation of Soil Treatment to Damage Caused by H. schachtii *and root-rot fungi.*

With a view to reducing eelworm infestation and at the same time minimizing any losses in yield which may occur due to this cause, or to the presence of root rot lesions on the roots of the plants, experiments were conducted at Nhill during 1935 to 1937, to study the effect of dressings of certain fertilizers, minerals, and other compounds on the severity of these diseases. Although no treatment produced any great effect on the amount of eelworm infestation, a very marked improvement in growth and yield resulted in certain instances, indicating that these particular treatments had effected an improvement in the host parasite relationship, enabling the plant to better withstand the deleterious effects of these organisms. The differences in yield produced by the various treatments were closely related to differences in root development. Free Gallipoli wheat sown at the rate of 75 lb. per acre was used in these experiments, while each individual plot was approximately 0.0346 acre in area.

The Effect of Manurial Treatment.—In these experiments the effect of the common fertilizers, superphosphate, potassium sulphate and sulphate of ammonia, on eelworm infestation was studied. Each treatment was replicated three times, and samples of plants were examined during the growing period to determine the relative effects of the manure on root growth and the occurrence of eelworm and root rot lesions. The yields of grain from each plot were also obtained. At the end of the season a composite soil sample was taken from each plot and a cyst count was made to determine the effect of the treatments on soil population. The results of these counts and yields of grain, resulting from each treatment, are shown in Table VIII.

The superphosphate plus sulphate of ammonia treatment produced a superior growth and root development of the plant early in the season compared with superphosphate alone, but this difference was not maintained during the latter part of the season, as the yields from these two treatments indicate. Both treatments produced a markedly superior growth to that of the untreated plants. Potash, on the other hand, had a deleterious effect on the growth and yield of the wheat. The growth in the plots treated with blood and bone manure was intermediate between the untreated and superphosphate plots. The eelworm cysts were common on the roots of plants from all treatments. Owing to the inferior root development of the untreated plants and those treated with potash, however, the branching of the roots resulting from infestation with *H. schachtii* was more noticeable in these treatments. The cyst counts revealed no significant differences in soil population. Garrett (12) has made similar observations to the effect that manurial treatment had no appreciable effect on the amount of eelworm infestation.

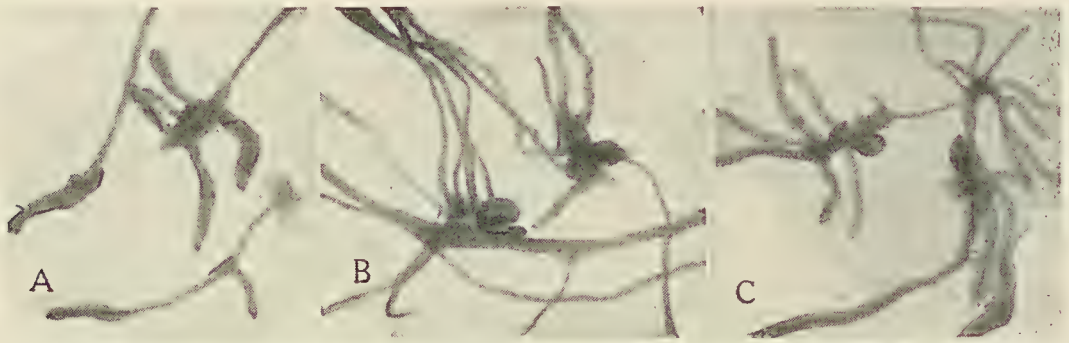

Fig. 38.—Showing the effect of soil temperature on the development of H. schachtii *in the roots of Free Gallipoli wheat grown in Nhill soil in the Burnley temperature tanks. Treatments: A, 60°F.; B, 70°F.; C, 80°F. Sample 38 days after germination. Note that the most rapid development occurred at 70°F.*

In 1935, root rot lesions were more common on the plants receiving potash alone than on those treated with superphosphate or sulphate of ammonia. No obvious difference between these latter treatments, as regards the prevalence of lesions was noticeable. The following fungi were isolated from them:—*Helminthosporium sp.*, *H. sativum*, *Curvularia ramosa*, *Rhizoctonia solani* and *Fusarium sp.*

TABLE VIII.—SHOWING THE EFFECT OF MANURIAL TREATMENT ON EELWORM INFESTATION AND YIELD AT NHILL, 1935–36.

Treatment.	1935.		1936.	
	Cyst Count per 72 Grams of Soil.	Yield (bushels per Acre).	Cyst Count per 72 Grams of Soil.	Yield (bushels per Acre).
Untreated	56	15·6	57	33·8
Superphosphate, 1 cwt. per acre	44	27·8	47	38·8
Superphosphate + sulphate of ammonia (1 : 1), 2 cwt. per acre	41	28·8	..	..
Potash, 1 cwt. per acre ..	47	12·0	..	..
Blood and bone, 1 cwt. per acre	..	..	62	36·4
Standard error ..	8·42	1·1	4·6	0·93

The Kansas Agricultural Experiment Station (8) reports fairly good control of foot rot of wheat (caused by *Ophiobolus graminis*) by the use of organic fertilizers. In the experiment at Nhill, in 1936, however, the use of the organic blood and bone manure had no apparent influence on the occurrence of root rot lesions with which the fungi recorded above were associated.

Schmidt (37) and Goffart (15) have reported that the emergence of larvae of *H. schachtii* from the cysts is stimulated by animal oil and bone oil. It was considered that the organic blood and bone manure used at Nhill might have a similar effect on the emergence of larvae leading to an earlier and more severe infestation of the plants grown on the area treated with this material. An examination of samples of plants taken from these plots throughout the season, however, did not reveal any difference in eelworm infestation when compared with the other treatments in the experiment.

The Effect of Minerals and other Compounds.—In conjunction with the 1935 manurial treatment experiment at Nhill, the effect of certain other compounds on eelworm infestation was investigated. These compounds were as follows:—sulphur, nictar dust and derris compound. The nictar dust contained approximately 50 per cent. of lead arsenate and 2 per cent. nicotine sulphate in a dolomite base, while the derris compound contained at least 15 per cent. of ether soluble rotonone. Each material was applied to their respective plots at seeding time by means of a drill. In addition the plots received superphosphate at the rate of 1 cwt. per acre.

In the early part of the season the sulphur treatment appeared to stimulate growth slightly, but towards the end of the year no difference in appearance was apparent between this treatment and superphosphate 1 cwt. Nictar dust had a very deleterious effect on the plants throughout the season which was reflected in the greatly reduced yields from this treatment (Table IX.). A marked reduction in yield also resulted from the derris treatment although early in the season it was much superior in appearance to nictar dust.

Three sets of plant samples were dug from these plots during the growing period, and an examination indicated that, compared with sulphur, derris and, to a greater extent, nictar dust had reduced root growth. The development of eelworms in the roots of the nictar plants was apparently slower than in the other treatments and cyst formation was not as common. No difference in the prevalence of cysts on the roots was noticeable between any of the other treatments.

The yields obtained from this experiment, which indicated that none of the compounds tested were of any value in eelworm control when applied at the rate of 1 cwt. per acre, are shown in Table IX. Ogilvie (36) and other workers found that sulphur had no remedial effect on eelworm infestation.

TABLE IX.—SHOWING THE EFFECT OF CERTAIN SOIL TREATMENTS ON THE YIELD OF WHEAT AT NHILL, 1935.

Treatment.	Yield (bushels per Acre).
Superphosphate, 1 cwt. per acre ..	24·2
Superphosphate, 1 cwt. + nictar dust, 1 cwt. per acre	13·5
Superphosphate, 1 cwt. + derris, 1 cwt. per acre	15·8
Superphosphate, 1 cwt. + sulphur, 1 cwt. per acre	24·0

In 1936, an experiment was conducted on the relation of mineral treatment to eelworm and root rot "sickness." In all, six treatments were included in this test. All plots received superphosphate at the rate of 115 lb. per acre in addition to their respective mineral treatment, as indicated in Table X. Each treatment was duplicated (Fig. 39). During the season certain observations, which are set out hereunder, were made on the effect of each treatment.

TABLE X.—MINERAL TREATMENT TEST, NHILL, 1936. DETAILS OF CYST COUNTS AND YIELDS OF WHEAT RESULTING FROM EACH TREATMENT.

Treatment.	Cyst Count per 72 grams of Soil.	Yield (Bushels per Acre).
Superphosphate, 115 lb. per acre	60	29·1
Superphosphate + zinc sulphate, 31 lb. per acre	59	38·5
Superphosphate + potassium permanganate, 50 lb. per acre	66	31·5
Superphosphate + sulphur, 60 lb. per acre	68	30·8
Superphosphate + copper sulphate, 22 lb. per acre ..	68	22·8
Superphosphate + borax, 34 lb. per acre	80	18·5
Standard error ..	8·7	0·46

Zinc Sulphate.—The effect of this treatment on the general growth of the wheat was outstanding. As a full report on this and subsequent experiments in which zinc sulphate was tested has been published (31), it is not proposed to repeat the results in this report (Fig. 40).

Fig. 39.—Portion of the mineral treatment experiment. Left, superphosphate; centre, super + zinc sulphate; right, super + copper sulphate.

Fig. 41.—Showing the effect of zinc sulphate on a bulk area of wheat at Salisbury, 1937. Left, superphosphate + zinc sulphate; right, super alone. Note the superior heading in the area treated with zinc. These plots were sown with the same variety on the same day.

Potassium Permanganate. — This treatment resulted in a slightly better type of growth than the control plots which is reflected in the increased yield obtained (Table X.). The root development of the plants was superior to the controls, but the adventitious roots were branched very close to the plant. This is in contrast to the zinc-treated plots, where the roots were unbranched for some distance from the plant. Cysts were common on the roots and root rot lesions were comparatively common also. While this treatment apparently had no effect on the final infestation of eelworms and the roots of the plants, it was noted that the worms in these plants tended to reach the cystic stage before those of any other treatment.

Observations made in the laboratory at Burnley, indicated that potassium permanganate exercises a stimulating effect in the hatching of the eggs of *H. schachtii*. A similar observation has been made by Goffart (15).

Sulphur.—Very little effect on growth was produced by this treatment, although the appearance of the plots was slightly better than the controls. The root development of the plants was similar to that produced by potassium permanganate, but the adventitious roots were not branched so close to the plant. As in the previous year, sulphur had no significant effect on eelworm infestation. Root rot symptoms were common and the following fungi were isolated from them :—*Curvularia ramosa*, *Fusarium* sp., *Rhizoctonia solani* and *Helminthosporium* sp.

Copper Sulphate.—Applications of copper sulphate at the rate of 22 lb. per acre proved definitely injurious to the growth of the wheat, and resulted in a markedly significant reduction in yield (Table X.). Root development was poor and the adventitious roots were fibrous, close to the plant. Cysts occurred commonly on the roots. Root rot lesions were less prevalent on the roots than for any other treatment. From those lesions present *Rhizoctonia solani* and *Helminthosporium* sp. were obtained. Copper sulphate had therefore, some effect in reducing the incidence of root rot. Mencacci (30), has observed a similar effect on foot rots due to copper sulphate.

Borax.—The application of borax to the soil, at the rate of 34 lb. per acre, produced a greater injurious effect on the growth of the wheat plant than that produced by copper sulphate. Root development was extremely poor. The worms were retarded in reaching the cystic stage, but at the end of the season, cysts were very prevalent on the roots. A large proportion of these were small in size. Although the cyst counts showed an increase in numbers in this treatment, the

difference was not significant. Root rot lesions were common on the roots. During 1937 the effects of further soil treatments on the incidence of eelworms and root rot fungi were studied, each plot being 0·0333 acre in area.

At the end of the season, samples of approximately 40 to 60 plants were obtained from the plots and were examined for the occurrence of disease. In place of the cyst count method of expressing the effect of treatments on eelworm infestation, an index of severity was obtained by the method described in the section of this report dealing with the effect of rotation. The treatments included in this experiment and the results of the plant examinations are shown in Table XI.

TABLE XI.—MINERAL TREATMENT EXPERIMENT, NHILL, 1937. SHOWING SEVERITY INDEXES OBTAINED FROM THE EXAMINATION OF SAMPLES OF PLANTS FOR THE OCCURRENCE OF DISEASE.

Treatment.	Root Rot Lesions Severity Index.	Eelworm Infestation Severity Index.
Superphosphate, 1 cwt. per acre	83·0	87·0
Zinc sulphate, 30 lb. per acre ..	74·8	83·2
Superphosphate, 1 cwt. + zinc sulphate, 15 lb per acre ..	81·7	75·2
Superphosphate, 1 cwt. per acre + zinc sulphate, 30 lb. per acre	75·8	77·2
Superphosphate, 1 cwt. + ammonium sulphate, 1 cwt. per acre	82·6	88·0
Superphosphate, 1 cwt. + ferric oxide, 27 lb. per acre ..	70·2	72·0
Superphosphate, 1 cwt. + ferrous sulphate, 30 lb. per acre ..	80·4	81·9
Superphosphate, 1 cwt. + magnesium sulphate, 39 lb. per acre	80·6	87·7

With regard to the severity indexes for both root rot lesions and eelworm infestation, although differences occurred between the control and certain treatments, particularly ferric oxide, it is doubtful whether any of these differences were significant owing to the wide variation in the figures within the treatment and to the limited number of replications.

As in the 1935 manurial experiment, ammonium sulphate produced a superior type of growth early in the season compared to the controls, but this difference was not maintained later in the season and no difference in yield, due to this treatment, occurred. Hynes (23) has reported that the use of ammonium sulphate effected some control of root rot caused by *Rhizoctonia solani*. Although it was not possible to demonstrate any such effect in the above experiments, the early response of the plants to this treatment at Nhill, may be partly related to some suppression of root rot development during the period of this response.

Compared with the controls, no difference in growth was noticeable in the plots treated with either ferric oxide or ferrous sulphate. The significance of the decrease in the severity index recorded for ferric oxide in Table XI., is doubtful. Various workers (7, 19, 20, 21) have found that these two iron compounds have some use in combating potato sickness associated with *H. schachtii*. Better results, however, were obtained by the use of calcium cyanamide.

In experiments on the control of "take-all" of wheat associated with *Ophiobolus graminis*, Hynes (25) obtained some control with an application of 5 cwt. per acre of ferrous sulphate. This chemical was also found to have a marked inhibitory effect on the growth of the fungus in culture. The very much lighter dressing used in the experiment at Nhill had no observable effect on the severity of root rot lesions. Magnesium sulphate at the rate of 39 lb. per acre did not produce any effect on growth or the severity of root rot lesions on eelworm infestation.

Depth and Time of Sowing in Relation to Eelworm Infestation.

Evidence was obtained as to the effect of depth and time of sowing on root rot development and eelworm infestation. These experiments were conducted during 1935 and 1936, and it was found that whereas, root development and yield were influenced by these factors, eelworm infestation was not affected.

Depth of Sowing—In the 1935 experiment, each treatment was replicated three times, while in the following year, only one plot of each treatment was sown to provide confirmatory evidence to the previous year's results. In the shallow sown plots the seed was just covered with soil, while in the deep sown treatment it was placed approximately 4 inches below the surface. All plots were sown with the drill and were 0.0346 acre in area. The variety of wheat used was Free Gallipoli.

In 1935, a much superior root system resulted from the deeper sowing, which was reflected in an increase in yield (Table XII.). No difference in the amount of eelworm infestation between the two treatments was noticeable. The following year was much more favorable for the growth

of the crop as the higher yields shown in Table XII. indicate. Even under these conditions, however, the deep sowing induced a slightly better growth than did shallow sowing, the adventitious roots of the former treatment being better developed. The infestation of worms was common on both sets of plants. Owing to the superior adventitious root development which it induces, deep sowing is desirable on areas infested with *H. schachtii*.

TABLE XII.—THE EFFECT OF DEPTH OF SOWING ON THE YIELD OF WHEAT IN 1935 AND 1936.

Treatment.	1935 Yield (Bushels per Acre).	1936 Yield (Bushels per Acre).
Sown deep	24·2	39·0
Sown shallow	21·6	38·5

Time of Sowing—Two varieties of wheat, namely Rajah and Free Gallipoli, were sown in the plots at Nhill in 1935 and 1936, at the end of May and the middle of July. A markedly superior growth was obtained from the early sowing as compared with the late one, which is in accord with general experience as to the effect of time of sowing, on the growth and yield of wheat.

Cysts were very common on the roots of plants from both treatments, but the better root development promoted by the early sowing resulted in a much better yield. Details of the yields obtained in 1935 and 1936 are as follows:—

Treatment.	1935 Yield (Bushels per Acre).	1936 Yield (Bushels per Acre).
Free Gallipoli—sown early ..	33·6	43·2
Free Gallipoli—sown late ..	21·7	21·6
Rajah—sown early	30·1	47·3
Rajah—sown late	25·2	27·0

From these results it is evident that early sowing is to be preferred on eelworm infested areas. Although this practice has no value in reducing the amount of eelworm infestation of the plants, the superior root development which it promotes, helps to offset any reduction in yield caused by eelworm attack.

Summary.

Investigations on the importance and control of the eelworms attacking cereals in the Wimmera district of Victoria have been carried out during the years 1934 to 1937, inclusive.

The worm and its life history are briefly described. It is considered that this form of *Heterodera schachtii* should be described as the wheat race.

An inoculation experiment proved the capacity of the eelworm to produce disease symptoms in wheat when grown under unfavorable soil conditions. In the field, however, a heavy infestation of eelworms on the roots of the plant does not necessarily lead to poor growth, while the worm is also very commonly associated with severe damage due to root rot fungi. The production of field symptoms is dependent upon the occurrence of eelworm infestation in combination with some nutritional defect.

Studies were made on the resistance of cereals to *H. schachtii*. Approximately 200 different varieties of wheat, oats and barley have been classified in accordance to their resistance to the worm. The oat varieties in particular, and the barley varieties to a lesser extent, exhibited varying degrees of resistance. The wheat varieties were most commonly and severely affected.

Observations were made on the comparative effect on soil population of these resistant and susceptible types of cereals. In contrast with the susceptible varieties, the growing of the resistant varieties resulted in a decrease in soil cyst population.

Preliminary studies were made on the pathology of eelworm infestation in resistant and susceptible types of plants. In their young stages, the roots of a wide variety of "non susceptible" plants are penetrated by the larvae of the worm, but no further development takes place. Resistant and susceptible cereal varieties are penetrated equally freely by the larvae, but development to the cystic stage occurs in the latter types only.

Development commences in the younger tissues of the root tips before the differentiation of the vascular elements has occurred. Giant cells and syncytia occur in the vascular area at the head end of the developing worm, and secondary roots are produced in wheat and barley in particular. No such changes occurred in the resistant Mulga oat variety. The differentiation of the vascular elements in the root tips of this variety occurs very rapidly, and the roots become "woody" in appearance. This "woodiness" may be a factor concerned in the resistance of the plant to eelworm attack.

During the period 1934 to 1937, the value of rotation in the control of *H. schachtii* was studied. Three years' fallow caused a marked reduction in cyst population of the soil, but proved insufficient to completely eliminate the worm. A somewhat similar reduction resulted from the sowing of "non-susceptible" plants such as peas or "natural pasture" for two years, followed by a year's fallow. Even after one year's treatment with such plants, the number of viable eggs remaining in the cysts was reduced, although no marked diminution in total cyst population occurred.

The cyst population of the soil was markedly increased by sowing Free Gallipoli wheat, whereas the resistant Mulga oats caused a marked reduction in the original cyst population. The sowing of a barley crossbred on one of the plots in 1937, also caused a reduction in population when compared with wheat. The yields of grain from the plots in 1936 and 1937 are given, together with brief notes on the effect of the treatments on the occurrence of root rot lesions.

It was not possible to demonstrate any relationship between cyst population and the following soil analyses:—Loss on ignition, sticky point, nitrogen, lime, phosphoric acid, and pH value.

The greatest proportion of eelworms occurs in the first 6 inches of soil. Below 12 inches, practically no cysts were obtained.

Soil treatment with fertilizers and minerals did not effect any reduction in eelworm infestation, but in certain instances, resulted in very marked increases in yield, due to improved root development. The most outstanding results in this regard were obtained by the use of 15 or 30 lb. zinc sulphate per acre in conjunction with 1 cwt. of superphosphate.

Both early and deep sowing induced superior root growths as compared with late and shallow sowing respectively, which was related to an improvement in the yields of the plants. Neither treatment proved to be of value in the control of *H. schachtii*.

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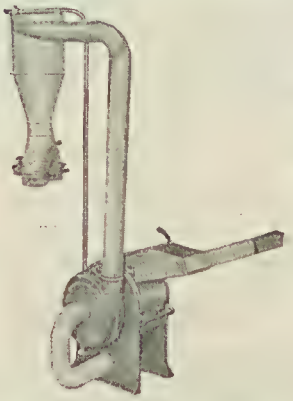

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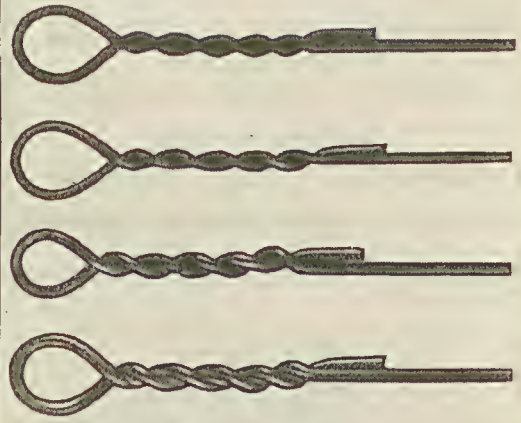

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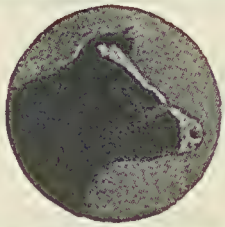

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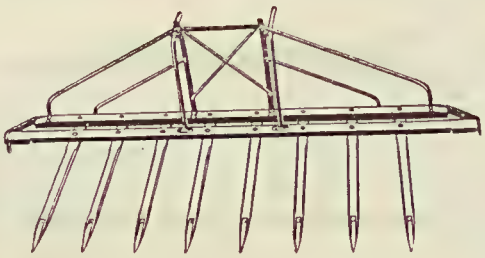

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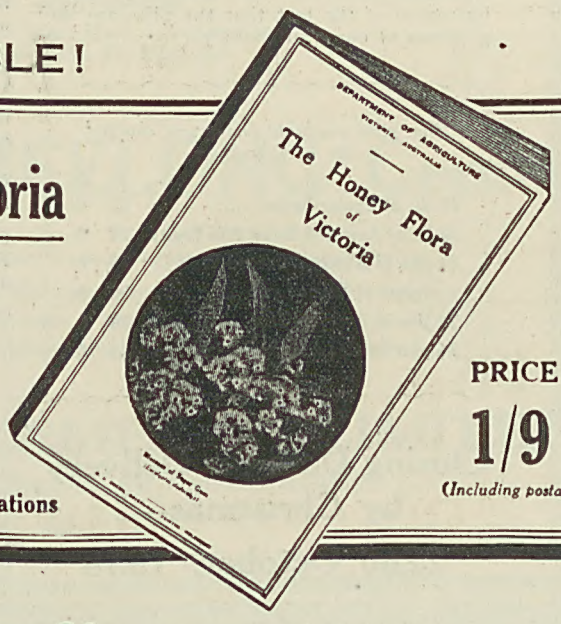

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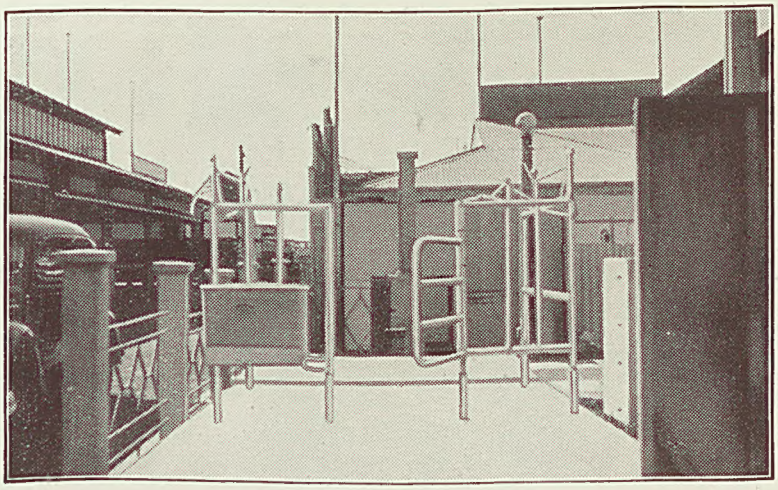

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